Scientific Review

AND

SCIENTIFIC AND LITERARY REVIEW,

A RECORD OF PROGRESS IN ARTS, INDUSTRY, AND MANUFACTURES,

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CONTENTS.

	PAGE.
ADVERTISEMENTS	33
APPLICATIONS FOR LETTERS PATENT	33
SCHOOL BOARD TYRANNY	34
ESTIMATING COAL GAS POWER	34
KRUPP'S SILICATE COTTON	34
TRADE MARK LAW AS AFFECTING INVENTORS	35
REVIEWS—	
Mivart's Lessons from Nature	36
Freehand Outline Drawings	38
Dr. Ball on Screws	38
RAILWAY TUNNELS	38
INVENTORS' INSTITUTE	39
ELECTRICITY CONSIDERED AS A MODE OF MOTION	39
PROCEEDINGS OF THE INSTITUTE	41
MONTHLY NOTICES	41
PROCEEDINGS OF SOCIETIES—	
Royal Society	42
Geographical Society	42
Zoological Society	42
Microscopical Society	42
Astronomical Society	42
Geological Society	42
Royal Society of Literature	43
Royal Institution	43
Physical Society	43
Psychological Society	43
Societies Continued—	
Anthropological Society	43
Society of Arts	43
Meteorological Society	43
Chemical Society	43
Linnean Society	44
Institution of Civil Engineers	44
ON RAILWAY SAFETY APPLIANCES	45
SHIP GEAR, &c.	46
INSTITUTION OF NAVAL ARCHITECTS	47
DRAMATIC LITERATURE	47
AMERICAN INVENTIONS	47
ADVERTISEMENTS	47

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APPLICATIONS FOR LETTERS PATENT.

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NEWS has been received of the discovery of another small planet, No. 159, made by M. Paul Henry at Paris.

SCHOOL BOARD TYRANNY.

THE relentless oppression of our School Board tyranny is still progressing, aided too often by the sympathy which some of our magistrates evince for supporting the *jus summum*, without reflecting that if the fulfilment of their functions is to be held to mean nothing more than following strictly the letter of the law, there would be no necessity that magistrates should be high-class well-paid officials, but might be intelligent lawyers' clerks, fully primed with statute law, to be let off as opportunity offered, who would consider themselves fully paid by the receipt of salaries of from one-half to two-thirds less in amount than those paid to our magistrates.

The first case is one that has been much noticed by the newspapers, namely, that of John Speer, of Canute-street, Rotherhithe, who appeared to an adjourned summons before the magistrate of Greenwich police-court, for not paying a fine of sixpence, with 2s. costs, for not sending his son to school. The defendant, who seemed very feeble, said he could not pay. He was nearly blind and unable to work, and his wife had only just got up after her confinement. He had two other children, and that morning they had only a pound of bread and a pennyworth of tea and sugar among the whole of them for breakfast. In reply to the magistrate the defendant said it was impossible for him to say when he could pay the money. Mr. Patteson thereupon committed him for five days.

The other case was one that has been talked over at the London School Board, in which a man pleaded that he had not sent his child to school because he had been ill, and contagious disease was in the house. And not being ready at the moment to pay the fine, the man was sent off to prison, and was there treated like any common felon by having his hair cropped. A nice commentary on school boardism and the summary jurisdiction of magistrates.

These cases are only samples; there are plenty where poor, struggling people have been oppressed in a similar way. We ourselves know of a case where a poor widow had to pawn her bed-clothes to pay a small fine!

ESTIMATING COAL GAS POWER.

BY MR. W. SUGG, ASSOC. INST. C.E.

NOTWITHSTANDING the attention which has been bestowed upon the subject, gas photometry was still in an unsatisfactory state. With even the most perfect apparatus, the same quality of gas was differently estimated in different places, because there was no generally recognised standard burner. The jet-photometer, originally invented by the late Mr. George Lowe, M. Inst. C.E., had been so improved that it was possible to ascertain, by simple inspection, the true illuminating power capable of being evolved from different coal gases.

It was generally acknowledged that the most accurate way of estimating the illuminating power of gas was by burning a known quantity of that gas in a standard burner, and comparing the light with that from a known quantity of oil or sperm, consumed in a certain kind of lamp or candle. In England, since the year 1852, the parliamentary standard of comparison had been a sperm candle, of six to the pound, burning at the rate of 120 grains per hour. But the average normal rate of burning of these candles was nearer 130 grains than 120 grains. Therefore it was desirable that the parliamentary standard rate should be altered, if a change could reasonably be made. The greatest obstruction to the adoption of a uniform system of gas photometry had always been the difficulty of settling the kind of burner with which the gas should be tested. With the standard quantity of the same gas, different kinds of burners gave different results; and the same burner gave different results with the same standard quantity of gases of different illuminating powers, richer or poorer, acording to the kind of gas it had been originally designed for. In 1863 Dr. Letheby designed, in conjunction with the author, a standard burner with a 15-hole incorrodible steatite top. Previous to this all testing burners had iron tops, which were subject to alteration by oxidation. The burner, known as the "Sugg-Letheby" 14-candle burner, was one of the parliamentary standard-testing burners for 14-candle gas, and was used, with a chimney 7 inches long and 2 inches wide, in England, in some parts of North and South America, in Canada, Australia, and New Zealand. There were, however, two other parliamentary burners for 14-candle gas, viz., one described in the Birmingham and Staffordshire Gas Act of 1864, for testing the gas supplied to Birmingham, Hanley, Hull, and, till lately, Brighton. The other 14-candle burner was that adopted by the gas referees for London in 1869. It was the invention of the author, and was known as Sugg's "London" standard Argand burner for 14-candle gas, and it was used for testing the gas supplied to the City and other parts of London by the Gas Light and Coke Company, by the Imperial and by the South Metropolitan Gas Companies, and by a number of companies in the provinces. It was also the new standard burner for the Dominion of Canada. The same standard quantity of the same quality of gas tested by these three burners showed very different powers of light, the "London" burner evolving the greatest, and the Birmingham the least, amount of light. The total difference was nearly three candles.

There were three different parliamentary standard burners for testing 16-candle gas, all to consume the standard quantity of 5 cubic feet per hour, viz., the "Dublin" 16-candle Argand 15-hole steatite top burner, used with a chimney 7 inches long by 2 inches wide; the Dublin flat flame 16-candle burner; and the "London" standard Argand for 16-candle gas with a 24-hole steatite top, to be used with a chimney 6 inches long and 2 inches wide. There was but one parliamentary standard burner for consuming 5 cubic feet per hour of 18-candle gas, viz., that described in the Leamington Gas Act, which was a modification of the "Sugg-Letheby" burner, the central aperture being enlarged to supply more air to the richer gas. The "London" 18-candle burner for the standard quantity of the same quality of gas gave an amount of light equal to about 2½ candles more than the Leamington burner. For 20-candle gas the parliamentary standard burner had been described by the gas referees as Sugg's steatite batwing, No. 7. It was used in London and in Liverpool. For 27 up to 32-candle gas it was customary to make use of any kind of fishtail burner, and to consume any quantity of gas, at the option of the operator. For Cannel gases there was no regularly authorised parliamentary burner.

By the system of the author, one standard burner only was proposed for all qualities of gas from twelve to thirty candles. This burner might be readily guaged and verified by actual trial against the Government standard burner. It was the gas referees' London Argand burner, with a chimney 6 inches or 7 inches long by 1¾ inch wide, producing a flame always 3 inches in height; in fact, such a burner as was ordinarily adopted by consumers. When used with 16-candle gas it would burn 5 cubic feet per hour with a 3-inch flame, the light from which would be equal to that given by sixteen sperm candles of six to the pound. The quantities of different qualities of gas required to produce in burning a 3-inch flame with this burner, were with 12-candle gas, 6·6 cubic feet; 14, 5·7; 16, 5·0; 17, 4·7; 18, 4·4; 19, 4·2; 20, 4·0; 25, 3·2; and 30-candle gas, 2·7 cubic feet.

Eight different sizes of "London" Argand burners were shown, which gave *pro rata* amounts of lights from different quantities of gas, varying from 2½ feet to 7½ feet per hour.

Of late years a gas referees' standard burner had been constantly used by the author as a standard light for testing various kinds of gas burners, and it had been found that the illuminating power as well as the appearance of the 3-inch flame, had been always constant, notwithstanding considerable variations in the quality of the gas. The proposed method for effecting a comparison was as follows: The gas referees' 3-inch flame burner having been fixed on a photometer in the place usually occupied by the standard burner, it was lighted, and allowed to burn off all the dead gas collected in the meter and fittings of the apparatus. Then a clean chimney was put on, and the height of the flame regulated by the aid of the usual micrometer cock and King's pressure guage to exactly 3 inches. The quantity of gas per hour required to give this flame was then found, and a reference to the table would show the examiner the illuminating power of the gas. The rest of the experiment was performed in accordance with the instructions of the gas referees, and would be a corroboration of the table, and at the same time a check upon the accuracy of the sperm candles, which were very subject to error. The result was the illuminating power of the gas in terms of the parliamentary standard quality of 5 cubic feet of gas and 120 grains of sperm candle. Every quality of gas tried upon this system would be fairly consumed, and a like quantity of gas would be designated by the same number of candles of illuminating power.

This Paper, which was read at the meeting of the Institution of Civil Engineers on February 15th, was illustrated by diagrams and an actual specimen of a new and simple apparatus, the invention of the Author, termed an "Illuminating Power Meter," by which the illuminating power of gas could be read off from a dial at once in standard sperm candles. No previous knowledge, either of the manufacture of gas, or its chemical composition, or of the mode of testing it, was requisite for the use of this novel instrument.

KRUPP'S SILICATE COTTON.—Messrs, Cresswell and Co., of Leadenhall-street, write to us with reference to this subject, referred to in *The Times* of the 6th instant. They say they learnt only recently from Mr. Friedrich Krupp that, although the Silicate Cotton sold by them is manufactured at his ironworks on the Upper Rhine, near Coblentz, it was not exactly his invention. Although this fact is of comparitively small importance, Messrs. Cresswell regret that circumstances over which they had no control should have induced the belief that such was the case, and that they are only at the eleventh hour made aware of the actual facts. All "Silicate Cotton" supplied by them for the purpose of covering steam boilers and pipes, safes, ice houses, fire-proof rooms, &c., and, in short, for all purposes in which the letting in and out of either heat or cold is the object, is produced at Friedrich Krupp's Works, as above mentioned, and is protected by their own trademark—viz., a Phœnix on a Star, with mining tools crossed.

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Arrangements are progressing for the improvement and ultimately the enlargement of the SCIENTIFIC REVIEW.

TRADE MARK LAW AS AFFECTING INVENTORS.

Trade Mark Law has very generally been considered as analagous to Patent Law and Copyright, and, in some sense, this is true; but it is distinct in its main principle, namely, that a Trade Mark is in truth a man's signature put upon his goods, therefore the imitation of one man's mark by another is a kind of forgery, hence a fit subject for the operations of the Criminal Law, a position which has been recognised by the Merchandize Marks Act, 1862.

Until recently, however, a great difficulty in regard to Trade Mark was this; the law had left its nature in a vague and uncertain position.—A mark was not a property—and yet in some law cases it seemed to be so treated. Certainly it was not simply the foundation of the criminal offence, of piracy of it, though as above stated, that was in some cases a criminal offence. It seemed rather to be an incidence of the goodwill of a trade or business to which it is now attached through, as a distinct proprietary right by the Trade Marks Registration Act, 1875 (see section 2), the registered owner of a Trade Mark being therein spoken of as "proprietor." That Trade Marks are of great importance to manufacturers, no one probably will venture to dispute, because if any person can get acknowledged as the producer of a certain class of goods, he will find the public will seek after his goods, and will disregard the offers of other persons who may, even truly enough, profess to sell articles as good, perhaps better, than his. Now the placing of his name, peculiar mark, or device on goods of his manufacture testifies to all the world that they are genuine productions of his.

There are, however, some people in the world of industry who never do anything but imitate the works of others. To these people Trade Mark is of no value for their own use, but is, moreover, an unpleasant hindrance, to remove which they not unfrequently become infringers or pirates of Trade Marks, and to repress this Trade Mark, law, both civil and criminal, is needed.

To inventors, patentees, and producers of novelties it will be readily admitted the use of a peculiar Trade Mark, and its proper protection must be of the greatest importance, because novel productions are the very things that require special evidence of genuineness. As regards patentees, this is especially the case, for the placing of the name of the patentee or his peculiar mark or device on genuine articles, made according to his patent, will serve to guarantee genuineness, and, furthermore, lead to the detection of piracies, as all goods not bearing his mark can, by the absence thereof, be known as infringements of his patent rights.

Trade Mark law has for some years past been very stringent, for independently of the power of stopping false marking by injunction, and repressing it by action for damages, the Merchandize Marks Act above-named has made the wrongful use or application of a Trade Mark a misdemeanour, punishable with two years' imprisonment, with or without *hard labour*, or with fine, or with imprisonment alone (see Section 14 of Act). The same Act also provides that the sale wilfully of articles having spurious Trade Marks thereon shall be punishable by summary conviction as a finable offence (see Section 4 of Act); and there are provisions for compelling mere dealers to give information as to the persons issuing to them goods bearing spurious marks (see Section 6 of Act).

Moreover, such fraudulently marked goods, and the instruments of marking, are forfeitable to the Crown, to be destroyed or dealt with as the Court directs. Thus it will be seen that Trade Mark law has not erred on the side of leniency; but for all that, until recently, it was defective in a very important point, namely, the want of registration of ownership, and fixity of character of the Mark. However, by the Act of last year—the Trade Mark Registration Act, 1875—this defect has been remedied, for registration was thereby established, and it was provided by Sections 2, 3, and 4, that a Trade Mark must be registered as belonging to particular goods or classes of goods; and when registered is capable of being *assigned and transmitted only in connection with the goodwill* of the business concerned in such particular goods or classes of goods, and shall be determinable with such goodwill, but subject as aforesaid registration of a Trade Mark shall be deemed to be equivalent to public use of such mark. The registration of a person as first proprietor of a Trade Mark shall be *primâ facie* evidence of his right to the exclusive use of such Trade Mark, and shall, after the expiration of five years from the date of such registration, be conclusive evidence of his right to the exclusive use of such Trade Mark, subject to the provisions of this Act as to its connection with the goodwill of a business. Every proprietor registered in respect to a Trade Mark subsequently to the first registered proprietor shall, as respects his title to that Trade Mark, stand in the same position as if his title were a continuation of the title of the first registered proprietor.

So it is now law that a Trade Mark can be registered, and thereupon becomes the exclusive right of the person registering, improper registration being carefully guarded against by elaborate arrangements (all which will be found detailed in the SCIENTIFIC REVIEW for December, 1875, (which contains a copy of the Act), and for February, 1876, which contains an analysis of the Rules and the Act construed together).

As far as inventors are concerned, this Trade Mark Registration Act is of the first importance, because the change made in allowing registration to supersede the necessity of getting the articles trade-marked into the market, as was formerly necessary (a great drawback to inventors and patentees), will enable every patentee to register and adopt a mark, and protect it for his own use and that of his licensees, and further enable him to advertise that all articles not bearing the mark are infringements, to deal in which will subject dealers to proceedings for infringement of patent. We were, therefore, much pleased to find that Mr. F. W. CAMPIN, Barrister-at-law, Secretary of the Inventors' Institute, brought this subject before the Inventors' Institute at its last meeting, when the nature and operation of Trade Mark Law as affecting inventors and industrial improvers were fully set forth in the way we have stated same in this article, and we own ourselves much indebted to Mr. CAMPIN.

Reviews.

MIVART'S LESSONS FROM NATURE.

"Lessons from Nature: as Manifested in Mind and Matter." By ST. GEORGE MIVART, Ph.D., F.R.S., Sec. L.S., F.Z.S.; Corresponding Member of the Academy of Natural Sciences, Philadelphia; Professor of Biology at University College, Kensington, &c. London: John Murray, Albemarle-street. 1876.

THIS work may be considered a grand demonstration in favour of the subordination of science to religion, especially that very positive and explicit form of religion which the orthodox Catholic upholds; but Dr. Mivart is a man of scientific eminence, and his work is well worthy of perusal by all who wish to learn the whole truth, and not to be bound by the opinions of any particular scientific investigator. Much of the work consists of reprints from various reviews, but in the present volume these have been rearranged and augmented.

The author, in the preface, thus refers to the scope and object of the work: Observation and experience have convinced me of the narrowing and misleading effects upon the mind of an incomplete conception of what is meant by the term "Nature."

It is too generally taken as denoting the assemblage of phenomena external to and apart from the human mind, which none the less is one of the most important objects which presents itself to our perception. Hence arises a necessary imperfection. But a worse evil follows. "Nature," taken in this limited sense, is often made use of to explain that which has been tacitly excluded from it. Thus it is that the facts and processes of reason are apt to be first ignored in order that they may be afterwards treated as if the mere phenomena of irrational nature were sufficient to explain them.

Impressed with this conviction, it has been my endeavour to point out in the following chapters (in however imperfect and fragmentary a manner) what I deem the most important lessons to be derived from "Nature," in the broad sense of that word as a great whole of which the mind of man forms part. For us, indeed, the facts of mind form the inevitable starting-point from which we must set out in order to study, logically, the phenomena of irrational nature, and to investigate, if we may, their cause and purpose. There is no doubt, in thus proceeding, a danger of Anthropomorphism—of attributing to the first cause merely human characteristics, and projecting as it were our personality, as in the Brocken shadow, far beyond its proper limits; but the danger of Anthropomorphism is at present much greater—the danger, that is, of allowing the facts of reason to be obscured and overshadowed by an analogously enlarged distortion of the world of sense, which ever so clamorously reiterates its claims on our attention and regard.

The work commences as a starting-point with discussing the question that our own continued existence is a primary truth known to us with supreme certainty, and this certainly cannot be denied without involving the destruction of all knowledge whatever. In the second chapter first truths are considered, and chapter three relates to the external world, and refers to prevalent scepticism on this subject amongst modern philosophers and its cause—Mr. John Stuart Mill, and Mr. Spencer's Transfigured Realism. Chapters four and five refer to language, and duty and pleasure, whilst in chapters six and seven man and the brute are brought under consideration. In chapter eight the likenesses in animals and plants are referred to, and amongst these likenesses is mimicry, as to which Dr. Mivart says:—

Not only moths, but also beetles imitate bees. Wasps and objects the most strange are also mimicked by beetles, such, *e.g.*, as dung and drops of dew. There are also creatures called bamboo or walking-stick insects, which present a most striking resemblance to twigs of bamboo. Concerning these Mr. Wallace tells us: "Some of these are a foot long and as thick as one's finger, and their whole colouring, form, rugosity, and the arrangement of the head, legs, and antennæ are such as to render them absolutely identical in appearance with dry sticks. They hang loosely about shrubs in the forest, and have the extraordinary habit of stretching out their legs unsymmetrically, so as to render the deception more complete."

But there are facts yet more extraordinary. Some insects which mimic leaves, mimic even the marks made upon leaves by the ravages of other insects or by mould. As to this Mr. Wallace further informs us, "One of these creatures obtained by myself in Borneo (*Ceroxylus laceratus*), was covered with foliaceous excrescences of a clear olive-green colour, so as exactly to resemble a stick grown over by a creeping moss or jungermannia. The Dyak who brought it me assured me it was grown over with moss although alive, and it was only after a most minute examination that I could convince myself it was not." In speaking of a leaf-butterfly he tells us that—"We come to a still more extraordinary part of the imitation, for we find representations of leaves in every stage of decay, variously blotched, and mildewed, and pierced with holes, and in many cases irregularly covered with powdery black dots, gathered into patches and spots, so closely resembling the various kinds of minute fungi that grow on dead leaves, that it is impossible to avoid thinking at first sight that the butterflies themselves have been attacked by real fungi."

These facts appeared to me some years ago to be of a nature which no amount of accidental minute indefinite variations acted on by the destroying agencies of nature (inducing the "survival of the fittest") could possibly account. I then said (opposing the Darwinian hypotheses of the origin of species by natural selection): "Now let us suppose that the ancestors of these various animals were all destitute of the very special protections they at present possess, as on the Darwinian hypothesis we must do. Let it also be conceded that small deviations from the antecedent colouring or form would tend to make some of their ancestors escape destruction by causing them more or less frequently to be passed over, or mistaken by their persecutors. Yet the deviation must, as the event has shown, in each case be in some definite direction, whether it be towards some other animal or plant, or towards some dead organic matter. But as, according to Mr. Darwin's theory, there is a constant tendency to indefinite variation, and as the minute incipient variations will be *in all directions*, they must tend to neutralise each other, and at first to form such unstable modifications that it is difficult, if not impossible, to see how such indefinite oscillations of insignificant beginnings can ever build up a sufficiently appreciable resemblance to a leaf, bamboo, or other object, for 'Natural Selection' to seize upon and perpetuate. This difficulty is augmented when we consider how necessary it is that many individuals should be modified simultaneously" and similarly in order that slightly favourable variations may hold their own against the overwhelming force and influence of mere number. A consideration insisted on in the "North British Review" for June, 1867, p. 286; a consideration of which review has compelled Mr. Darwin to modify his views very importantly, and he has himself confessed that until reading this article he did not "appreciate how rarely single variations, whether slight or strongly marked, could be perpetuated."

As repudiating the theory that likenesses are due to inheritance, Dr. Mivart says,—A very obvious example of likeness not explicable by "descent" is the familiar one between our right hand and our left. This likeness is part of that general correspondence which exists between the right and left sides of most animals, and which is spoken of as "bilateral symmetry," *lateral homology*. Another example is that likeness which sometimes exists between parts placed one above another, as between the upper and lower parts of the tail-fin of most fishes. Such likeness is an example of "vertical symmetry," or *vertical homology*. Another kind of "likeness," or homology, is termed "serial." It is chiefly in our limbs that this kind of homology is manifested externally in us, but it is plainly enough to be seen in the human skeleton (or in that of any backboned animal), in the ribs or in that series of generally similar bones (vertebræ) which made up the vertebral column or backbone. Our limbs, however, do present, even externally, a certain degree of similarity, the thigh, leg, and foot of the lower limb evidently more or less repeating the upper arm, arm, and hand of the upper limb.

Mr. Herbert Spencer, in his "First Principles of Biology," attempts to explain these and all facts of structure, not due to inheritance, by the action upon each organism of its environment. Thus he explains the very general absence of symmetry between the dorsal and ventral (upper and lower) surfaces of most animals by the different conditions to which these two surfaces are respectively exposed. But it may be objected that this is no real explanation, but a mere restatement of the facts. No reasons have been given by him showing either how or why each organism so responds to such external differences of environment, or how such differences in environment tend to produce such particular modifications. Mr. Spencer, indeed, beautifully illustrates that correlation which, however produced, all must admit to exist between the structure of organisms and their surrounding conditions, but he quite fails to show that such conditions are the *cause* of such structure. His argument is, indeed, an example of the old fallacy *post hoc ergo propter hoc*. I believe the cause to be not external but internal. If animals and plants respond so readily to the action of external incident forces, it must be the case that conditions exist in such animals and plants which dispose and enable them so to respond, according to the maxim, *Quicquid recipitur, recipitur ad modum recipientis*, as the same rays of light which bleach a piece of silk blacken nitrate of silver. If, therefore, we attribute the external forms of organisms to the action of external conditions, we but remove the difficulty a step back, since we must conceive an internal power and tendency occasioning such ready modifiability of structure. But, indeed, it is not at all easy to see how the influence of the surface of the ground, or any conceivable similar external condition or influence, can produce such differences as those existing between the dorsal and ventral shields of the shell of a tortoise.

The likenesses, then, which exist between arm and leg, and between hand and foot, are hardly to be explained by any mere action of the environment. But serial homology is much better exemplified in a very different group of animals from backboned creatures—namely, the group to which all insects, lobsters, centipedes, leeches, and earth-worms belong—the group of Annulose animals. In the centipede, the body (except at its two ends) consists of a longitudinal series of similar segments. Each segment supports a pair of limbs, and the appendages of all the segments (except at each end of the body) are completely alike. In most other creatures of the Annulose group, the fundamental similarity between the successive segments of which the body is composed is more or less disguised. Thus, for example, in the lobster a number of the anterior segments of the body are united together into one solid mass, while only in the abdomen (the so-called tail) do the segments remain distinct. The limbs also, which at first are all similar, assume, with the development of the young lobster, different forms, and become respectively jaws, claws, legs, and swimming-feet. The peculiar and strongly marked serial homology of these Annulose animals has been the subject of an exceedingly ingenious suggestion by Mr. Herbert Spencer. In his work just referred to he has attempted to explain such serial homologies thus:—Some animals of a very low grade propagate themselves by spontaneous fission—one individual spontaneously dividing, and so becoming two distinct individuals. If certain creatures found benefit from this process of division remaining incomplete, they would (on the theory of Natural Selection) transmit to their posterity a naturally selected tendency to such incomplete division. It is conceivable that certain animals might thus have come to assume the form of a chain of similar segments, *i.e.*, a chain of imperfectly separated individuals. Such a chain would, of course, in one kind of animal be the equivalent of a series of perfectly separated individuals of another kind of animal in which the process of fission was completely carried through. In other words, Mr. Spencer would explain the serial homology of Annulose animals by the supposed coalescence (through imperfect fission) of organisms of very simple structure, such as the small aquatic worms called *Planariæ*, in one aggregated, longitudinal series through the survival of the fittest aggregation. This is a very ingenious speculation, yet not only is there no evidence that *Planariæ* propagate by fission, but there is positive evidence which directly conflicts with Mr. Spencer's hypothesis. Mr. Mosely, in his investigations of the land *Planariæ* of India, has brought forward evidence that a single *Planaria* is the equivalent not of a segment of a leech, but of a whole leech. Yet a leech is the morphological equivalent of a whole centipede, lobster, or other higher Annulose animal, and therefore each higher Annulose animal must be regarded as itself a morphological unit, and not an aggregation of such units.

As to natural selection, perhaps the concluding portion of the chapter on it will give a fair notion of our author's views:—The answer may seem surprising to some, but it is none the less true, that "natural selection" is simply nothing. It is an apparently positive name for a really negative effect, and is therefore an eminently misleading term. By "natural selection" is meant the result of all the destructive agencies of nature, destructive to individuals and to races by destroying their lives or their powers of propagation. Evidently the cause of the distinction of species (supposing such distinction to be brought about in natural generation) must be that which causes variation, and variation in one determinate direction in at least several individuals simultaneously. At the same time it is freely conceded that the destructive agencies of nature do succeed in preventing the perpetuation of monstrous, abortive, and feeble attempts at the performance of the evolutionary process, that they remove rapidly antecedent forms when new ones are evolved more in harmony with surrounding conditions, and that their action results in the promotion of new characters when these have once attained sufficient completeness to be of real utility to their possessor.

Continued reflection, and five years' further pondering over the problem of specific origin, have more and more convinced me the conception that the origin of all species, "man included," is due simply to conditions which are (to use *Mr. Darwin's own words*) "strictly accidental," is a conception utterly irrational. This conception is not that of Mr. Wallace, who makes of man a special exception. With regard to the conception as now put forward by Mr. Darwin, however, I cannot truly characterize it but by an epithet which I employ only with much reluctance. I weigh my words, and have present to my mind the many distinguished naturalists who have accepted the notion, and yet I cannot hesitate to call it a "*puerile hypothesis.*" I call it peurile and not infantine, because in the infancy of nations as of individuals the tendency is to explain each visible action by a direct supernatural intervention. Reaction from this *infantine* condition tends to the exclusion from our conception of the First Cause, of knowledge, purpose and will altogether, as in the Ionian Philosophy which reappears amongst us today—the *puerile* view. This puerile view results from a want of appreciation of human reason. *Maturity* reconciles the apparently diverging truths contained in each assertion and represents the material universe as always and everywhere sustained and directed by an infinite Cause, for which to us the word MIND is the least inadequate and misleading of symbols.

As to sexual selection, which is treated of in the tenth chapter, we extract the following passage:—Another instance, which Mr. Darwin considers a "striking case," is that "a male silver-pheasant, who had been triumphant over the other males, and was the accepted lover of the females, had his ornamental plumage spoiled. He was then immediately superseded by a rival, who got the upper hand, and afterwards led the flock." But, in the first place, what is the meaning of "got the upper hand?" If this means "conquered in fight," the whole case is simple enough; and without such conquest it is difficult to see how the second male could have "afterwards led the flock." But even if it does not mean conquest, it need only mean that the change of plumage caused an interruption in the associated sensations of the females, such that they mistook his identity, and no longer recognised their mate. But a solitary observation of Dr. Jaeger requires confirmation, and is indeed of little value in supporting what, if it be correct, is but a hypothetical interpretation of its meaning, while numerous other observations directly contradict any such hypothesis. Thus Mr. Darwin himself says of fowls:—

"I have received long letters on this subject from Messrs. Hewitt and Tegetmeier, and almost an essay from the late Mr. Brent. It will be admitted by every one that these gentlemen, so well known from their published works, are careful and experienced observers. They do not believe that the females prefer certain males on account of the beauty of their plumage." "Mr. Tegetmeier is convinced that a gamecock, though disfigured by being dubbed with his hackles trimmed, would be accepted as readily as a male retaining all his natural ornaments." As to pigeons, "Mr. Tegetmeier, at my request, stained some of his birds with magenta, but they were not much noticed by the others" (vol. ii. pp. 117, 118).

But there are remarkable instances of sexual characters which cannot be due to female selection or to selection at all. Thus Mr. Darwin was shown by Mr. Bartlett that the *inside of the mouth* of the hornbill, *B. bicornis*, "is black in the male and flesh-coloured in the female" (vol. ii. p. 129). Again, we learn that "the *females* of *Paradisea apoda* and *P. papuana* differ from each other more than do their respective males" (vol. ii. p. 192). And again, "The males of two species of *Oxynotus* (shrikes), which represent each other in the islands of Mauritius and Bourbon, differ but little in colour, whilst the females differ much." Moreover, Mr. Darwin compares these with "certain sub-breeds of the game fowl, in which the females are very different, whilst the males can hardly be distinguished"—differences which he allows *we cannot explain*. And indeed the fact that sexual plumage may arise without any sexual selection whatever, or indeed selection of any kind, is abundantly demonstrated by the case of the pigeons before noticed, and by the fact that in fowls "the two sexes of pencilled Hamburgs differ greatly from each other, and from the two sexes of the aboriginal *Gallus Bankiva*" (vol. ii. p. 158).

Mr. Darwin bases his theory of sexual selection greatly on the fact that the male birds display the beauty of their plumage with elaborate parade and many curious and uncouth gestures. But this display is not exclusively used in attracting and stimulating the hens. Thus he admits that "the males will sometimes display their ornaments when *not* in the presence of the females, as occasionally occurs with the grouse at their balz-places, and as may be noticed with the peacock; this latter bird, however, evidently wishes for a spectator *of some kind*, and will show off his finery, as I have often seen, before poultry or even pigs" (vol. ii. p 86). Again, as to the brilliant *Rupicola crocea*, Sir R. Schombergk says: "A *male* was seen capering to the apparent delight of several *others*" (vol. ii. p. 87).

Mr. Alfred Wallace has, in the following passage, well expressed two objections to Mr. Darwin's theory of sexual selection which have also occurred to the minds of others:—

"There are two difficulties in the way of accepting Mr. Darwin's wide generalisation as to the agency of sexual selection in producing the greater part of the colour that adorns the animal world. How are we to believe that the action of an every-varying fancy for any slight change of colour could produce and fix the definite colours and markings which actually characterise species? Successive generations of female birds choosing any little variety of colour that occurred among their suitors would necessarily lead to a speckled or piebald and unstable result, not to the beautiful and definite colours and markings we see. . . How can the individual insects of hundreds of successive generations of female birds produce any such definite or constant effect? Some law of necessary development of colour in certain parts of the body and in certain hues is first required, and, then perhaps, in the case of birds, the female might choose the successive improvements as they occurred; though unless other variations were altogether prevented, it seems just as likely that they would mar the effect the law of development of colour was tending to produce."

"The other objection is, that there are signs of such a tendency, which, taken in connection with the cases of caterpillars, of shells, and other very low organisms, may cover the whole ground in the case of insects, and render sexual selection of colour as unnecessary as it is unsupported by direct evidence. In many islands of the Malay Archipelago, species of widely different genera of butterflies differ, in *precisely the same way* [the italics are ours] as to colour or form, from allied species in other islands. The same thing occurs to a less degree in other parts of the world. Here we have indications of some local modifying influence which is certainly not sexual selection. So, the production in the males only of certain butterflies of a peculiar neuration of the wings, of differently formed legs, and especially of groups of peculiarly formed scales only to be detected by microscopical examination, indicate the existence of some laws of development capable of differentiating the sexes other than sexual selection."

But it is not only insects, but also birds, which present similar parallel variations connected with locality, and certainly not due to sexual selection. The element of caprice, which Mr. Wallace urges as an objection, is admitted by Mr. Darwin himself, for he speaks of sexual selection as depending "on an element eminently liable to change—namely, the taste or admiration of the female" (vol. ii. p. 192).

Mr. Wallace himself accounts for the brilliant colours of caterpillars and many birds in another way. The caterpillars which are distasteful must be gained, if "some outward sign indicated to their would-be destroyer that its prey was a disgusting morsel." As to birds, he believes that brilliance of plumage is developed where not hurtful, and that the generally more sober plumage of the hens has been produced by natural selection killing off the more brilliant ones exposed during incubation to trying conditions.

Now, as Mr. Wallace disposes of Mr. Darwin's views by his objections, so Mr. Darwin's remarks tend to refute Mr. Wallace's positions, and the result seems to point to the existence of some unknown innate and internal law which determines at the same time both coloration and its transmission to either or to both sexes. At the same time these authors plainly show the *harmony* of natural laws and processes one with another, and their mutual interaction and aid.

Thus it is reasonable to suppose that whatever cause has produced brilliant colour in either fishes or caterpillars may have produced thom in both. But so far from brilliancy producing concealment in coral-reef frequenting fishes, as Mr. Wallace believes, Mr. Darwin says, "According to my recollection they were thus rendered highly conspicuous." As to their so giving evidence of being unpalatable, he adds, "It is not, I believe, known that any fish, at least any fresh-water fish, is rejected from being distasteful to fish-devouring animals" (vol. ii. p. 18). This, of course, does not prevent the brilliancy of caterpillars being due to its warning-off power, but it tends to show that it can exist without any such cause; while mere brilliancy is by no means all that has to be accounted for, but a variety of stripes, spots, and definite patterns, the evolution of which, as they are not protective or selected, must be referred to some internal law.

As to the dulness of female birds being due to protective "natural selection," Mr. Darwin objects (vol. ii. p. 21) that fish which sit and hatch their young are brilliant enough. Quoting from Agassiz, he says: "It ought to be observed that these sitters are among the brightest species of their respective families; for instance, *Hygrogonus* is bright green, with large black ocelli, encircled with the most brilliant red." Again of the pipe-fishes: "The genus *Solenostoma* offers a very curious exceptional case, for the female is much more vividly coloured and spotted than the male, and she alone has a marsupial sack and hatches the eggs." Again, in some lizards we meet with the same phenomena as in so many birds, namely, a greater soberness of colour in the females. As Mr. Darwin most justly remarks: "The less conspicuous colours of the females in comparison with those of the males cannot be accounted for, as Mr. Wallace believes to be the case in birds, by the exposure to danger of the females during incubation" (vol. ii. p. 37).

But if in these cold-blooded classes we have this sexual difference developed by an innate law, why may not a similar cause produce the phenomena in question in the class of birds also?

We could quote other passages which are well worthy of special notice, but space prevents our doing so, and we can only say that this work is a powerful antagoniser of the materialistic theories so popular just now.

FREEHAND OUTLINE DRAWINGS.

"The Minerva Series of Freehand Outlines."
Moffatt, Page, and Co., Paternoster-row.

THESE will be found of great assistance to inefficient artists. There are a variety published as headed. Those forwarded for inspection are vases and leaves. The vases are Elizabethan, Greek, and Roman, Chinese and Renaissance; the leaves include the ivy, the oak, the sycamore, the hop, the burberry, the beech, the Virginia creeper. It is impossible to avoid recommending these easy means of acquiring the artistic art. When light, study, and beauty are united, there is no difficulty in certifying as to merit. We are given to understand that the drawings are according to the South Kensington School. In that case the high testimonials usually obtained by the students are good credentials. We have noted the various exhibitions of drawings and paintings, and some of the styles are very fascinating, but to accomplish perfection it would be desirable to begin with the study of outlines such as is presented in the Minerva Series. Schoolmasters and college principals have a good deal in their power in the education of to-day, and if drawing be a necessary ingredient in modern education, they should avail themselves of the means indicated. When we note the crowds which assemble in front of the establishments displaying any kind of specimens of drawings or paintings, it is impossible to deny the power of the artist. Hence the means of acquiring the art without difficulty are valuable. Of the drawings before us, traced in ink, the vases are certainly the most beautiful, but there are a variety of subjects being brought out besides as part of the series. The vine leaf and the Arabian vase are very pretty drawings. The common ivy is another good specimen. There is an acorn given with the oak, and the character of the whole indicates an increased facility of pursuing the study in schools.

DR. BALL ON SCREWS.

"The Theory of Screws: a Study in the Dynamics of a Rigid Body." By ROBERT STAWELL BALL, LL.D. Dublin: Hodges and Foster.

THIS is a valuable work of true science; in it Dr. Ball gives an elaborate analysis of the dynamic forces involved in, or to be evolved from, the actions of screws.

The forces investigated are based upon the demonstrations of Poinsot and Chasle, that any system of force can be reduced to a single force combined with a couple in a perpendicular plane, and that a body can be moved from any one position to any other by sliding along a line combined with rotation round it, *i.e.*, the motion of a nut on a screw; from this it has been deduced that forces and couples are compounded according to the same laws as rotations and translations respectively.

Upon these principles Dr. Ball's analysis proceeds. The actions of several screws with combined motions are very fully considered. Indeed, the work is an elaborate scientific treatise on this interesting subject.

REVIEWS, &C., POSTPONED.—Watt's "Earth in Danger." (Allen and Clark.) Also we have been obliged to postpone our notice of Mr. Wavish's invention.

RAILWAY TUNNELS.

BY G. J. MORRISON, ESQ., M. INST. C.E.

THE following gives the substance of Mr. Morrison's paper recently read at the Institution of Civil Engineers:—

The proper ventilation of any space consists in the supply of so much fresh air, at a suitable temperature, that the impurities occasioned by the presence of animals, or by any other cause, might never be injurious to health or unpleasant to the senses. In this paper pure air is considered to contain $3\frac{1}{2}$ parts of carbonic acid in 10,000, the percentages of oxygen and of nitrogen being respectively 21 and 79 by volume. The combustion of the fuel in ordinary locomotives gave rise to carbonic acid, carbonic oxide, sulphurous acid, and, if the fuel contained hydrogen, to water, by the combination of the various elements with the oxygen of the air. One pound of carbon generated $31\frac{1}{2}$ cubic feet of noxious gas; in the case of complete combustion this was carbonic acid containing $31\frac{1}{2}$ cubic feet of oxygen, but when the combustion was incomplete the result was carbonic oxide containing $15\frac{3}{4}$ cubic feet of oxygen. One pound of sulphur in burning combined with twelve cubic feet of oxygen formed twelve cubic feet of sulphurous acid. The amount of the organic exhalations was almost infinitesimal compared with that caused by the locomotive, and might be neglected.

The amount of fresh air that must be added to reduce the proportion of impurities, when generated, to such a point as would prevent them from being injurious or unpleasant was next discussed. When the enormous quantity necessary for this purpose was considered, it might be supposed there must be some mistake, because existing tunnels were tolerably well ventilated; but with natural ventilation the result was obtained with a far smaller expenditure than was necessary when artificial ventilation was introduced, particularly in short tunnels. In the case of natural ventilation, the vapour from the engine was hotter and lighter than the air, and at the ends of the tunnel the impure air found an exit at the top while fresh air entered at the bottom; and thus the tunnel was kept tolerably clear and wholesome by an interchange of air, which would have an inappreciable effect if introduced and allowed to mix thoroughly with the products of combustion. Wherever a double current existed at the ends of a tunnel, the purification of the air was being carried on in the most economical manner, and should not be interfered with.

Cases were then considered of the amount of air that should be admitted into a tunnel to keep down the proportion of impurities to a point at which they would be harmless, in the course of which it was contended that the atmosphere of the Metropolitan Railway was not actually unwholesome or injurious to health. The means to be taken to introduce fresh air into a tunnel were next discussed, the power required to effect this, and the amount of traffic that could be carried on without rendering the air unwholesome. The best arrangement for applying the power, so as to insure the supply of a proper amount of fresh air, was shown to be by introducing some means of withdrawing the air from the centre of the tunnel. When this method could be adopted, no other could compete with it. No valves or doors were required. The air entered at the ends of the tunnel; and as the tunnel was filled from both ends, the speed necessary to give a proper amount of ventilation was only one-half what it would be if the current entered at one end and passed out at the other. This system had been adopted at the Lime-street tunnel, Liverpool. That tunnel was about $1\frac{1}{4}$ mile long and the air in it was entirely changed in eight minutes by a fan. There was a considerable incline. The engine going uphill burned a large amount of fuel, but those going downhill consumed very little. The coal-burning traffic was conducted in one direction only. When the fan was not at work the tunnel cleared itself by natural ventilation in forty-five miuutes. It was shown that for short tunnels, with trains every few minutes, or for very long tunnels, with a smaller number of trains, this intermittent system would not be suitable. In the case of the Mont Cenis tunnel 7·6 miles long, with sixteen trains per day, consuming on the average 35 lbs. of carbon per mile, the tunnel would have to be filled once for each train that passed through. With the existing traffic, there did not seem to be any urgent necessity for artificial ventilation; but if the traffic should ever reach twenty trains per day, mechanical ventilation would probably be an absolute necessity. Even at present the workmen in the tunnel occasionally suffered severely from local accumulations of carbonic acid. To remedy this state of matters, a pipe 8 inches in diameter had been laid through the tunnel. Air was forced into this pipe, and there were cocks at intervals, to supply the workmen with fresh air. If artificial ventilation became necessary, a current would have to be made to traverse the tunnel from one end to the other.

It was concluded that if the methods for working long tunnels continued to be the same as were now used in the open air, then, even with the aid of artificial ventilation, a tunnel seven miles long was about the longest through which a large quantity of heavy traffic could be passed without inconvenience to the passengers. If a shaft and the ventilating apparatus were in the centre of the tunnel, a great advantage was gained not only in convenience, but in power. A tunnel of fourteen miles in length, with a shaft in the middle, was equivalent to two tunnels of seven miles each, needing, therefore, for ventilation, twice the power required for one tunnel of seven miles; while a tunnel of fourteen miles required sixteen times the power, not to mention other difficulties. In the case of a tunnel twenty-two miles long, ventilated by a current of air having a velocity of ten miles per hour, the indicated horse-power of the engine would have to be 900. A tunnel of this length could be entirely cleared in about two hours, no matter how foul it had been previously. The different methods of exhaustion, which was considered best for the purpose of ventilation, were then considered, and various kinds of fans referred to. Means for removing the impurities generated by an ordinary locomotive were discussed. One pound of lime was capable of absorbing about $\frac{3}{4}$ lb. of carbonic acid, so that with about 150 lbs. all the carbonic acid given off per train mile would be absorbed. The hot-water locomotive had been suggested as fit for such work, and boilers with a receptacle inside for a mass of red-hot iron, or heated fire-bricks; but these and the compressed air engine were shown to be inadmissible. The pneumatic system would involve all the trouble and expense of ventilation, and would not give as great facilities for working as many others; and the difficulties attendant on the atmospheric system were detailed. It was contended that the rope presented the most feasible method of working long tunnels.

Finally, Mr. Morrison concluded: 1. That when long tunnels without shafts had to be ventilated, a current of air should be caused to pass through by means of a fan placed near one end, that end being closed by doors. 2. That for a given amount of traffic, the power required to ventilate long tunnels varied as the fourth power of the length. 3. That when a long tunnel had to be ventilated, it was more advantageous to have a double-line tunnel, with trains in both directions, than two single-line tunnels, each having trains in one direction only. 4. That for every tunnel there was a limit to the amount of traffic that could be carried by locomotives, beyond which ventilation became impossible; that when this limit had been reached, some tractive power other than coal-burning locomotives must be employed; and that this limit could not be definitely fixed, but that for a tunnel of twenty-two miles in length, it did not exceed a total of twenty trains per day.

"Marine Engineering News" is the title of a new serial devoted to purposes which are sufficiently expressed in its title, comes out under the conduct of Mr. M. A. Soul. We wish it the successful career which anything with which he is connected deserves.

INVENTORS' INSTITUTE.

The subject of Patent Law Amendment occupied the attention of the members' meeting on 10th February, 1876, the President of Council, Sir Antonio Brady, being in the chair, who opened the proceedings by adverting to the recent case before the Master of the Rolls, of Plymton *v.* Malcolmson, relative to rink skates. And he pointed out that the case as reported in the public prints seemed to him to conclusively demonstrate that our Patent Law should be so amended that full official investigation into novelty should be made before a patent is granted. The whole of that case appearing to involve objections as to the novelty of Mr. Plympton's patent at the time of his application for it, and to the sufficiency of his specifications, both of which objections might well have been inquired into and decided previous to the granting of the patent, whereby the expensive litigation incurred could have been avoided. Sir Antonio further remarked that at the present moment no one knew what course would be taken by the Government in the present session of Parliament in regard to the Patent Laws, but he counselled the Institute to be in a state of preparation, and he was glad to state that a first step had been taken that evening by the appointment of Sub-Committee to consider the question with special reference to the case he had adverted to.

Admiral Selwyn said he had recently returned from the United States, where he had again been impressed by the superiority of the American views on the subject of the Patent Laws over those entertained by a large number of persons of position in this country. Inventors must in every way benefit this country by saving human labour, by increasing human comfort, and facilitating the production of articles of commerce and convenience, but then both as an incentive to the exercise of inventive power and the sustenance of the inventor (who it must be ever kept in mind was more often a working mechanic or some person of equally small pecuniary status than a possessor of wealth or pecuniary competency), it was requisite that the exercise of invention should have a fair chance of securing remuneration, for which purpose good Patent Laws were needed. To obtain the enactment of such laws was one of the principal objects of the Inventors' Institute, but this was in our country no light task, for, somehow or other here, inventors were regarded as robbers of mankind instead of being accounted as they ought to be —benefactors. As a loyal Englishman, he would remark that reform of the Patent Laws was a primary national question, for this country had now arrived at a crisis when it was absolutely necessary that all its talent should be brought forward in aid of our naval, military, and manufacturing progress. Viewing the matter in this way, he recommended immediate movement on the part of the Institute, and considered that the Sub-Committee appointed by the Executive Council that evening was a step in the right direction.

Mr. Savage considered the patent question as a part of the larger question of the relations of capital and labour, for he could see no difference between the labours of an inventor and the labours of an artizan, who, in fact, often sustained both characters; hence the amendment of the Patent Laws was a primary question for workmen of intelligence.

Mr. Thos. Paterson said that, although he had found by experience that in this country men were very slow to move, yet he considered that the movement in favour of Patent Law amendment had now begun, owing, doubtless, to the persistent efforts of such men as Sir Antonio Brady, Admiral Selwyn, and Mr. Campin, the secretary of the Institute; for when (in 1870) he was occupied in the management of the Workmen's International Exhibition, he found it immensely difficult to get working men to pay any attention to the subject of the Patent Laws; now they were everywhere alive to the importance of the matter as affecting their well-being. He thought that all those inventions which at the present day constituted the majority of the patented improvements, namely, small steps, were usually the productions of working men, and the pecuniary benefit which might result from a patent afforded an artizan a legitimate avenue of escape from a life of toil to comparative ease. Moreover, a good Patent Law would induce brain cultivation, which was a great desideratum for working men, especially at the present time.

Mr. Newton Wilson referred to the great importance of the question, and hoped that previous to the Institute appearing again before the Government and Legislature, some of the points of the question would be carefully reconsidered by the Institute. Compulsory licences seemed to him to involve a question which the Institute must deal with; as he would venture to say the Government would insist upon its forming part of an amended Patent Law; therefore, it was no use to waste strength in endeavouring to oppose the system *in toto*. Let the Institution rathes devote its attention to the rectification of the details of the proposed system so as to render it beneficial, or, at least, innocuous. He thought that the question of improvements upon another man's patent should receive consideration from the Institute, and then, above all, cheap provisional protection should be insisted upon as a main provision in the new Patent Law.

Mr. Murray opposed the notion of Mr. Newton Wilson in regard to compulsory licenses, as a system of that kind would be a gross violation of the rights of inventors, and in many cases would render patent property a mere sham.

Mr. F. H. Varley would merely observe that if the question of resemblance in inventions were not carefully handled the Patent Laws must always be in an unsatisfactory state.

Dr. J. McGrigor Croft, Mr. M. M. Harris, and other gentlemen supported the views of the President and Mr. Paterson.

A vote of thanks to the chairman brought the proceedings to a close, the meeting having first expressed by their plaudits the satisfaction felt at the announcement that Admiral Selwyn had recently obtained his Admiralship.

ELECTRICITY CONSIDERED AS A MODE OF MOTION.

By Bertie C. Carey, Esq.

When the phenomena caused by electric currents are considered, it seems probable that electricity is a mode of motion, and the thought suggests itself that this mode of motion is similar to that of heat and light. Proof is difficult; we can but tell by reasoning out the different effects which should be caused by electric currents—supposing the electric currents to be a mode of motion—and then see if these results are caused. And we can tell in the same way what should cause electric currents, supposing these electric currents to be a mode of motion, and then see if electric currents are produced by these causes. There is no actual proof of the ether, which is supposed to exist in space; neither is there actual proof of electricity being a mode of motion. But reason points to the existence of the ether, and so it does to the fact of electricity being a mode of motion.

The chief points to be considered are these:—

I. That electricity is a form of motion.

II. That this form of motion is similar to the forms of motion called respectively *heat* and *light*.

III. The velocity of electricity.

a. The swing of the molecules is larger than the swing of the molecules in *heat* or *light*; the waves produced in the æther are therefore longer.

b. The waves travel from place to place as fast as those of light, without decreasing in length.

IV. The direction of the vibrations of the particles is *transverse*.

If electricity be a certain mode of motion, that which causes this certain mode of motion will produce electricity.

And if that form of motion be the same as that called *heat* and *light*, that which causes the motion productive of heat and light, will cause the motion producing electricity.

a. Friction causes heat and light.
Friction causes electricity.
b. Pressure causes heat and light.
Pressure causes electricity.
c. Percussion causes heat and light.
Percussion causes electricity.
d. Cleavage causes heat and light.
Cleavage causes electricity.
e. The earth is a source of heat and light.
The earth is a source of electricity.
f. Chemical action is a source of heat and light.
Chemical action is a source of electricity.

Here are six causes of heat and light, which are at the same time causes of electricity.

Heat is caused by friction, for friction produces a vibratory motion amongst the molecules of a body rubbed.

Electricity is caused in precisely the same way—not from having the fluids decomposed.

Percussion and cleavage produce vibrating motion among the molecules, so that according to theory, heat, light, and electricity should be the results. They are.

The earth radiates heat—conveys to the ether the movement necessary to produce heat. But with this vibratory motion giving heat and light, there should be electricity. There is, and it is called terrestial magnetism.

Chemical action is a source of vibratory motion, hence a source of heat and light,—vibratory motion. Is there, then, no electricity? There is.

Thus, where vibratory motion is caused, the result is heat, light, and electricity, and as this vibratory motion is itself heat and light, so is it also electricity, the sensation received depending upon the length and velocity of the waves.

Having come to the conclusion that electricity is not a substance, but a *condition of matter*, the next thing to be considered is, what is this condition? If electricity be vibratory motion, at what rate is this motion transferred? In fact, what is the velocity of electricity?

The light waves are much shorter than the heat waves, therefore each light wave is of much shorter duration than a heat wave. The light waves are shorter by half (about), quicker by half (about), and are nearly twice as numerous. The length of these waves depends upon the swing of the molecules. If the swing is long, the waves are long, *i.e.*, heat, and a short, quick swing gives a short quick wave, *i.e.*, light.

The waves of heat are *longer* and *lower*, and there are consequently fewer to the inch than those of light, and the waves of electricity are *longer* than those of heat, therefore there are fewer to the inch. Thus, supposing in the distance x there are 600 waves of light, there would be about 350 waves of heat and 200 waves of electricity (these numbers are, of course, just for the sake of argument).

How many waves of electricity there really are to an inch I cannot say, but the number is *less* than in an inch of heat waves. The wave is longer, and is slower than the waves of heat and light.

The long waves go a greater distance than the short ones—each long wave goes further than each short one.

Each molecule swings over a certain distance in a certain time, and the result is electricity; when the same distance is swung over by two shorter and quicker vibrations, the result is heat; and when the distance is swung over by three still shorter and quicker vibratory molecules, the result is light.

The velocity at which a current of electricity travels from one place to another varies; ordinarily it may be said to go as fast as light.

But supposing it to be possible to increase the velocity of the swinging molecules, without decreasing the distance that they swing — without diminishing the length of the wave radiated, or generated —what would be the result?

Consider first that each wave of electricity is so much longer than one of either *heat* or *light*; that it is equal in length to nearly two of heat and nearly four of light; therefore, the length of one wave is two and four waves' length respectively, thus—*each* electric wave goes slower than each wave of heat or light. But see the result of increasing the velocity of each wave of electricity without diminishing its length, till it equals the velocity of each wave of heat. The result must be intense heat—electric heat.

Increase this velocity till each long wave of electricity equals the velocity of each short wave of light. The result must be light of the most dazzling brilliancy. For there will be the powerful swing of electricity and the rapidity of light.

And if *each* wave of electricity were to go at the speed of *each* light wave, the same distance would be gone over in as much less time as the difference in length of the two waves. So that under these conditions the current of electricity would be travelling faster from place to place than light.

Heat produced by the electric current is the most intense heat known.

Light produced by the electric current is of dazzling brilliancy.

We are led to believe, therefore, that the time of the swing of molecules *can* be accelerated without the length of the swing being shortened.

The Leyden jar is one way of obtaining the long quick movement. (Batteries and other things also produce this.) When Wheatstone calculated the velocity at which electricity travelled he used the Leyden jar. The vibrations then were at the velocity of those of light, for light was produced; and if the waves were long the current would be travelling at a rate considerably above that of light. It was.

Thus, substances give out short and quick vibrations, called ordinary light; long and slow vibrations, called ordinary heat; very long and very slow, called ordinary electricity; or long and quick, called electric heat; long and very quick, called electric light.

Electricity being a mode of motion similar to that of heat and light, it might fairly be assumed that the vibrations are transverse; but of this there is a proof. When a bar of soft iron is subjected to an electric current, sounds are produced which are sounds caused by transverse vibrations.

Having now considered all the points put forward, and having seen that electricity is a form of motion similar to that of heat and light, that the waves are *longer*, therefore it is capable of travelling faster than light, and that its vibrations are in a transverse direction, it will be as well to see a few of the results of these vibrations.

In the two fluid theory, the positive and negative were considered as two distinct things. It is more probable that in the positive the vibrations are quicker than those in the negative wire.

Unless, then, there is inequality of motion, there will be no current, for without a positive and negative there is no current. In this case when the vibrations are increased to such an extent that the sensation of heat is the result, there should be different degrees of heat in wires producing an electric current.

What do we find? In "Fragments of Science," p. 177, are these words:—"As long as the two opposite faces of the thermo-electric pile are kept at the same temperature, no matter how high that may be, there is no current generated. The current is a consequence of a *difference* of temperature between the two opposite faces of the pile."

As electricity is a mode of motion, which appears in bodies before that of heat, if that motion is obtained a current should be the result.

What do we see? Putting a piece of wire into the fire will produce the vibratory motion of heat. Are there no electric vibrations? Yes,—for when a plate of metal is bent over a magnetic needle, that needle is deflected when one end of the wire is heated.

If two different metals are used, they may be found at one end; their loose ends applied to the magnetic needle, it shows that there is an electric current when the joined part of the two metals is heated. This is because they are conductors in different degrees; one is better than the other—just the reverse of compensating metals.

Brief as these notes are, I hope they may meet with consideration from those who have greater opportunities than I have for study and research, and who possess greater experience in this branch of physical science.

AN interesting relic of pre-historic London, the massive lower jaw-bone of a hippopotamus, with its tusks and teeth, lately exhumed from a depth of forty feet, has recently been exhibited at the rooms of the British Archæological Association.

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Past Presidents:

SIR DAVID BREWSTER, K.H., LL.D., F.R.S., &c., from the establishment of the INVENTORS' INSTITUTE, till his decease, February, 1868. LORD RICHARD GROSVENOR, M.P.

President of Council:

SIR ANTONIO BRADY.

SESSION 1875-76.

MEMBERS' MEETINGS AT 8 P.M.

Thursday, March 9th.—Patent Law Conference.

Thursday, March 23rd.—"On Lighting Railway Trains with Gas, including Regulators;" by H. A. F. Duckham, Esq.

Council Meetings at 7 p.m.

Subscriptions are payable to Mr. G. A. STRETTON, the Receiver, 4, St. Martin's-place, S.W., who is the proper official to give receipts. F. W. CAMPIN, Sec.

Proceedings of the Institute.

THE Executive Council, on 27th January, was occupied with the proceedings preliminary to the Members' Meeting on the subject of Safety Railway Appliances on same evening, of which latter meeting we give a full report in another column.

At the Meeting of Executive Council on 18th February, Sir ANTONIO BRADY in the chair, after the minutes of the last meeting had been read and confirmed as correctly entered, a discussion occurred preliminary to that which occupied the subsequent Members' Meeting on the same evening, in which the President, Admiral Selwyn (Vice-President of the Institute), Dr. J. McGrigor Croft, Messrs. A. J. Murray, F. H. Varley (Vice-President of Council), M. M. Harris (Treasurer), Mr. T. Morgan, Mr. D. J. McLauchlan, and Mr. S. Calley took part, when it was resolved, on the motion of Admiral Selwyn, seconded by M. M. Harris, Esq.:—"That Mr. Malcolmson be invited to attend a meeting of a Sub-Committee of Council of the Inventors' Institute, in order to his giving explanations of his case, Plympton *v.* Malcolmson, so as to enable the Council, in the changes that may take place in the existing Patent Law, to consider what recommendations should be made thereon by the Council." It was also resolved further:—"That the Sub-Committee be the President of Council; Admiral Selwyn, Dr. J. McGrigor Croft, Mr. F. H. Varley, Vice-President of the Council, and the Secretary."

At a Members' Meeting on 24th February, Mr. F. W. Campin read his paper "On Trade Mark Law," Mr. McLauchlan occupying the chair. The substance of this paper is incorporated in our first article.

Monthly Notices.

The Lord Chancellor's new Patent Bill was presented to the House of Lords on 22nd February; it seems that, although it is an amendment upon the Bill of last Session, it is still very objectionable. We expect to be able to overhaul it next month.

MM. Chasles and Decaisne, having an absolute majority of votes, were elected members of the Administrative Central Commission of the Academy.

The International Exhibition of Scientific Apparatus, which is to be opened on the 1st of April next, is to be located in the Western galleries, in Prince Albert-road.

The Surveyor's Chain, legal standard sixty-six feet, and builder's chain of one hundred feet, the Warden of the Standards has, it appears, made arrangements for laying down on the north side of Trafalgar-square. The mural standards are to be fixed at the same site.

The Institution of Civil Engineers.—The list of members of this Association, corrected to the 2nd Feb., shows, that there were on the books at that date, 843 members, 1,530 associates, 14 honorary members, and 373 students, making together 2,760 of all grades.

The superseding of the Sounding Line is to be effected by an instrument, as to which Dr. Siemens, F.R.S., C.E., whose rare skill in the practical application of philosophical principles in scientific research has long been recognised, has presented a paper to the Royal Society, in which a description is given of this instrument, which determines the depth of the sea without the use of a sounding line.

The action of suspended coal dust in producing explosions of fire-damp in coal mines, as noticed by Mr. W. Galloway (in the *Athenæum*, Jan. 1, p. 27), has already been experimented upon by a Commission under the auspices of the Société de l'Industrie Minérale at Saint-Etienne, whose report and experiments are noticed in the Society's *Journal* for 1875. They prove that common air laden with coal-dust would be explosive either by the flame of gunpowder or a naked light. Several cases of explosion have been traced to the action of coal-dust even when no gas was present in the workings.

M. Chevreul communicates to the Académie des Sciences de Paris a paper on Petrifaction, in which he proves that the process of change in organic matter comprises two epochs—the first being the absorption of mineral matter through capillary action, and the second the disappearance by oxidation of the organic matter, and the substitution of the solidifying mineral matter, taking the actual form of wood. M. Daubrée stated that he had confirmed this view by experiments made upon wood in the hot baths of Bourbonne-les-Bains.

The Death of Mr. N. T. Wetherell should, says the *Athenæum*, be taken notice of, for he was a member of the old "London Clay Club," It took place at Highgate, on the 22nd of December, 1875. Mr. Wetherell, for many years, devoted his attention to the study of the fossils of the London clay, and he made a careful collection of the fossils from the glacial-drift deposits of Finchley and Muswell Hill. The London clay fossils are preserved in the British Museum, and those from the glacial drift in the Museum of Practical Geology. Mr. Wetherell was one of the earliest members of the Geological Society. He communicated several papers to the *Proceedings* and *Transactions*; others will be found in the *Quarterly Journal of the Geological Society*, and in the *Geological Magazine*. He was seventy-five years of age when he died.

Mr. Crookes, by a paper at the Royal Society, embodies an account of his further researches in "Repulsion resulting from Radiation," showing that already his radiometer is susceptible of practical application to scientific purposes in the domain of photometry, and that light can be weighed. If there be no mistake in this last particular—if the phenomenon be not the effect of repulsion—it will surprise physicists to learn that light has been taken out of the class of imponderables. Mr. Crookes' experiments are naturally attracting much attention. Dr. F. Neesen and M. Poggendorff have articles upon the "Radiometer" in *Poggendorff's Annalen*; the conclusion arrived at being, that the experiments have conduced to the realization of an apparatus, thermo-electric in character, possessing extraordinary sensibility with respect to the heat-rays.

Proceedings of Societies.

ROYAL SOCIETY.

JANUARY 13TH.—Dr. Hooker, C.B., President, in the chair. The following paper was read :—" On the Optical Deportment of the Atmosphere with reference to the Phenomena of Putrefaction and Infection," by Dr. Tyndall.

January 20th.—Dr. Hooker, President, in the chair.—Lord Aberdare and Mr. Sclater-Booth were elected Fellows. The following papers were read : " Certain Cases of Electromotive Force Sustained by the Action of Electrolytes on Electrolytes," by Mr. J. Hopkinson,—" On Reversed Photographs of the Solar Spectrum beyond the Red, obtained on a Collodion Plate," by Capt. J. Waterhouse, — and " On the Structure, Physiology, and Development of *Antedon* (Comatula Lam.) *rosaceus*," by Dr. Carpenter.

January 27th.—Dr. Hooker, C.B., President, in the chair.—The following papers were read : " On the Variations of the Daily Mean Horizontal Force of the Earth's Magnetism, produced by the Sun's Rotation and the Moon's Synodical and Tropical Revolution," by Mr. J. A. Broun,—" Results of the Monthly Observations of Magnetic Dip, Horizontal Force, and Declination made at the Kew Observatory, April, 1869—March, 1875," by the Kew Committee,—" Contributions to the Minute Anatomy of the Thyroid Gland of the Dog," by Dr. E. C. Baber,—and " Minute Anatomy of the Alimentary Canal," by Mr. H. Watney.

February 3rd.—W. Spottiswoode, Treas. and V.P., in the chair.—The following papers were read : " On Formulæ of Verification in the Partition of Numbers," by Mr. J. W. L. Glaisher,—" On the Development and Succession of the Poison Faugs of Snakes," by Mr. C. S. Tomes,—" On a Mechanical Integrator having a New Kinematic Principle," by Prof. J. Thompson,—" On an Instrument for Calculating $(\zeta\phi(x)\psi(x)dx)$ the Integral of the Product of two given Functions," " Mechanical Integration of the Linear Differential Equations of the Second Order with variable Co-efficients," and " Mechanical Integration of the General Differential Equation of any Order with Variable Co-efficients," by Sir W. Thomson.

GEOGRAPHICAL SOCIETY.

JANUARY 24TH.—Major-Gen. Sir Henry C. Rawlinson, President, in the chair.—The following gentlemen were elected Fellows : Col. J. C. M'Neill, Col. S. W. Stuart, Capt. S. Anderson, Capt. C. W. Andrew, Capt. E. C. Royse, Rev. G. A. B. Smith, Dr. V. Ambler, Dr. J. S. Davies, Messrs. W. M. Adams, J. Bishop, R. L. Bridger, S. H. Candler, T. S. V. Cocks, W. H. Cole, T. A. Denny, J. Forster, F. M. Fry, G. P. E. Green, W. Henty, F. J. Horniman, H. A. Kettle, W. Lort, F. C. Maltby, B. M'Murdo-Wright, M. J. Nagaoka, D. G. Rutherford, A. Stuart, and E. Solbé. The paper read was " Capt. the Hon. G. Napier's Recent Journeys on the Turcoman Frontier of Persia," by Major-Gen. Sir F. J. Goldsmid, with remarks by the President.

ZOOLOGICAL SOCIETY.

JANUARY 18TH.—Robert Hudson, F.R.S., V.P., in the chair.—Prof. A. H. Garrod, F.Z.S., read a paper on the peculiarity in the carotid arteries and on other points in the anatomy of the ground hornbill. *(Bucorvus abyssinicus.)* Mr. Edward R. Alston read a paper on the classification of the order glires. Lilljeborg's sub-orders *Glires simplicidentati* and *duplicidentati* were recognized, the former being divided into sections equivalent to Brandt's sub-orders *Sciuromorphi*, *Myomorphi* and *Hystricomorphi*. A third sub-order was proposed for the reception of the fossil form *Typotherium*. A communication was read from Mr. E. A. Liardet, containing notes on the land shells of Taviuni, one of the Fiji Islands, with descriptions of several new species. Mr. E. A. Schafer read a paper prepared by himself, and Mr. D. J. Williams on the structure of the mucous membrnce of the stomach in the kangaroos, in which he gave a minute description of the histological characters of the different portions of this organ. A communication was read from Mr. W. H. Hudson, C.M.Z.S., containing notes on the habits of the rails of the Argentine Republic. The Hon. W. H. Drummond read a paper on African rhinoceroses, in which he gave reasons for believing in the existence of five species in Africa, including *R. oswelli*, which, however, might brobably be merely a variety of *R. simus*. A communication was read from Mr. E. Pierson Ramsay, C.M.Z.S., containing a continuation of his remarks on the birds met with in North-Eastern Queensland, chiefly at Rockingham Bay. A communication was read from M. L. Taczanowski, C.M.Z.S., containing the description of a spotted deer found in Southern Ussuri—district of Amoorland, for which he proposed the name *Cervus dybowskii*. Mr. A. G. Butler communicated a revision of the Lepidopterous genus *Teracolus*, with descriptions of the new species.

February 1st.—G. R. Waterhouse, Esq., V.P., in the chair.—The secretary read extracts from a report of a recent visit made by H.M.S. Peterel to the Galapagos Islands, referring to the tortoises met with in the different islands of the group. Mr. Sclater exhibited and made remarks on an antler of a Rusa deer, living in the gardens of the Acclimatisation Society of Melbourne ; and Mr. F. Selous, jun., on a series of horns of African rhinoceroses procured by himself in South-eastern Africa. Papers and letters were read by Prof. T. H. Huxley, on the position of the anterior nasal aperture in Lepidosiren, which he showed to be strictly homologous with the position of these organs in other vertebrates ; by Mr. A. H. Garrod, on the anatomy of *Chauna Derbiana*, and on the systematic position of the Screamers (Palamedidæ), in which he controverted Prof. Parker's collocation of this form with the Anseres, and showed that it should occupy an independent position with relations to the Struthiones, Gallinæ, and Rallidæ ; from Mr. F. J. Bell, on the myology of the limbs of *Moschus moschiferus ;* from T. S. Cobbold, on Entozoa, forming the third of a series of papers on this subject brought by him before the Society ; by Mr. H. Druce, on a list of butterflies collected in Peru, with descriptions of new species ; to these were added some notes on some of the species by Mr. E. Bartlett ; by Mr. A. G. Butler, on a small collection of butterflies received from the New Hebrides ; and by Mr. P. L. Sclater and Mr. O. Salvin, on some new birds obtained by Mr. C. Buckley, in Bolivia.

MICROSCOPICAL SOCIETY.

ANNIVERSARY MEETING.—February 2nd.—H. C. Sorby, Esq., President, in the chair. The Report of the Council and the Treasurer's annual statement of accounts were submitted to the Fellows, and showed that the Society was, at the present time, in a satisfactory and prosperous condition. Votes of thanks to the President and Council for their services during the past year were proposed by Mr. J. Glashier and carried unanimously. The President then delivered the customary Annual Address, the subject of which was the probable limit of the powers of the microscope with reference to the ultimate size of the molecules of matter, and the general bearing of the conclusions arrived at upon the various germ theories. The subject was handled and worked out in an elaborate manner, and elicited the applause of an interested audience. The thanks of the meeting to the President for his Address were moved by Mr. C. Brooke and carried. The following gentlemen were elected as Officers for the ensuing year : President, H. C. Sorby ; Vice-Presidents, C. Brooke, Dr. W. B. Carpenter, Rev. W. H. Dallenger, and H. Powell ; Treasurer, J. W. Stephenson ; Secretaries, H. J. Slack and C. Stewart.

ASTRONOMICAL SOCIETY.

JANUARY 14TH.—Prof. Adams, President, in the chair.—A paper by the Astronomer-Royal was read, " On the Present State of his Calculations for his New Lunar Theory." Capt. O. Browne read a paper, " On the Times of the Phenomena of the Transit of Venus." He compared the times given by the observers at the different Egyptian stations, and showed that the observations might be divided into three classes, in the first of which it seemed probable that the observers had noted as the time of internal contact the moment at which a *shadowy* ligament was first formed between the limbs of the planet and the sun. In the second class, it appeared that the observers had noted as the time of internal contact the moment at which a *black* ligament, as dark, or nearly as dark, as the planet's disc, was first seen between the limbs of the planet ; and the sun observers of the third class had waited for what he termed geometrical contact, or the moment when the discs of the planet and the sun appeared to have a common tangent. Mr. Burton said that the chief difficulty which he had experienced in noting the exact moment of internal contact at ingress arose from the bright line which was seen surrounding the dark limb of the planet before it entered upon the sun's disc ; this prevented him from determining the moment when the solar cusps actually met around the disc of the planet. Mr. Christie described a new form of solar eye-piece which he had devised. It consisted of a series of glass prisms placed between the eye-piece and the eye of the observer in such a manner that the light was reflected nearly at the polarizing angle, and when the prisms were turned round relatively to one another the intensity of the ray entering the eye could be adjusted with great nicety. The chief advantages of this plan were, that by placing the prisms between the eye-piece and the eye the reflecting surfaces could be kept small, and the eye-piece could be used as a photometer for comparing the intensity of very bright lights, as it was evident that the intensity of the reflected and emergent rays could be easily calculated directly the positions of the prisms were known.

GEOLOGICAL SOCIETY.

JANUARY 5TH.—J. Evans, Esq., F.R.S., President, in the chair.—Messrs. J. K. Blakey, F. Hovenden, and T. Lovell were elected fellows. The following communications were read :—" Historical and Personal Evidences of Subsidence beneath the Sea, mainly if not entirely in the Fourteenth and Fifteenth Centuries, of several Tracts of Land which formerly constituted parts of the Isle of Jersey," by Mr. R. A. Peacock,—and " On the Physical Conditions under which the Upper Silurian and succeeding Palæzoic Rocks were probably Deposited over the Northern Hemisphere," by Mr. H. Hicks.

January 19th.—J. Evans, Esq., F.R.S., President, in the chair.—J. B. Bevington, W. P. Blake, J. G. Brickenden, E. G. Dyke, R. H. Gunn, W. J. Harrison, and R. G. Warton were elected Fellows. The following papers were read : " On some Unicellular Algæ parasitic within Silurian and Tertiary Corals, with a notice of their presence in *Calceola sandalina* and other Fossils," by Prof. P. Martin Duncan,—and " How Anglesey became an Island," by Prof. A. C. Ramsay.

ROYAL SOCIETY OF LITERATURE.

JANUARY 26TH.—C. Clark, Q.C., in the chair. Mr. Browning read a paper "On the Old Northern (Icelandic) Language and Literature, with Illustrations drawn from Icelandic MSS.

ROYAL INSTITUTION.

FEBRUARY 7TH.—The Duke of Northumberland, President, in the chair. Mrs. Mitchell, Mrs. T. Williams, Messrs. J. R. Adams, A. Brewin, E. De La Rue, C. Fletcher, T. Matthew Gisborne, M. Archer-Shee, jun., F. L. Smith, and A. B. Thorburn were elected Members.

PHYSICAL SOCIETY.

JANUARY 15TH.—Prof. Gladstone, F.R.S., President, in the chair.—Prof. Woodward exhibited a novel form of apparatus for showing either the longitudinal motion or sound-waves or the transverse vibrations of those of light. It consists of a series of balls, suspended in a horizontal line, which rest against a series of transverse partitions in a wedge-shaped trough. If this be drawn aside in the plane of the balls, and then slowly depressed, the motions of the particles will illustrate the phenomena of a sound-wave, while by displacing the trough parallel to itself prior to depressing it, the balls will oscillate parallel to each other, and will illustrate the nature of a wave of plane polarized light. Mr. Lockyer made a communication "On some recent Methods of Spectroscopy." Among these were (1.) The application of photography to securing permanent records of solar and other spectra; (2.) The determination of the absorption-spectra of vapours; (3.) The determination of what would be the spectra of absolutely pure metals, &c., if attainable; (4.) A quantitative spectroscopic analysis. The apparatus by means of which Mr. Lockyer is now securing a valuable series of photographs of spectra, was exhibited, and several of these were shown upon the screen. Mr. Lockyer also pointed out several necessary precautions. A photograph comparing the spectra of aluminium and calcium was exhibited, in which it was noticeable that many lines were common to both; but those which are thin in one are thick in the other, and *vice versa*. By results of this nature it is proved that no two simple substances contain any lines in common, and no substance is spectroscopically pure. Mr. Lockyer saw in these results the germ of a quantitative spectrum analysis, and experiments since carried on by himself and Mr. Roberts fully confirmed the opinion, but the method, although extremely delicate, cannot yet be looked upon as trustworthy. The examination of absorption-spectra at low temperatures by Roscoe and Shuster, and Mr. Lockyer, and at a high temperature (that of the oxyhydrogen blowpipe) by Lockyer and Roberts, show that these spectra can be divided into five distinct classes, depending upon the number of molecular simplifications through which the substance has gone.

January 29th.—Prof. Gladstone, President, in the chair.—The following candidates were elected members:—Sir J. Conroy and Mr. H. S. Burls. The secretary read a communication from Mr. J. A. Fleming "On the Polarization of Electrodes in Water free from Air." The experiments described were undertaken in order to meet objections which had been raised by Prof. Rowland to a previous paper by the author, in which he endeavoured to show that when an electrolyte flows in a very long magnetic field, the electromotive force generated by its motion affects the electrolysis of the liquid, a fact which he holds to be proved by the subsequent polarization of the electrodes. Mr. S. P. Thompson gave a summary of the recent experiments made in America by Mr. T. E. Edison, Dr. Beard, Prof. Houston, and others upon the new phase of electric manifestation, the so-called etheric force. This force is characterized by a faint spark, the only evidence, in fact, yet known of its existence. It may be obtained from the iron core of any electro-magnet, or from a metallic bar slipped into the coil in place of the core, but only when the battery circuit is being interrupted, as may be done by introducing into the circuit an automatic contact breaker. The sparks so produced are apparently without polarity, devoid of chemical or physiological effect, affect neither electroscopes nor galvanometers, and are stated to be retroactive, being exhibited when one end of a wire through which they are passing is brought round to touch the wire. A detailed description was then given of experiments on this force conducted in the Physical Laboratory at South Kensington, some of which were confirmatory of the published researches of the discoverers, while others were at variance with them. Great pains had been taken to avoid leakage, and to distinguish the effects from those of ordinary induced currents. The batteries and coils employed were insulated from the earth, as well as from the other portions of the apparatus. A bar of zinc placed above the poles of a powerful electro-magnet, or within its coils, was found to give better results than one of cadmium, is which recommended by the discoverers. The sparks, which resembled those of dynamic electricity, were of inappreciable length, and far too faint to ignite gun cotton or illuminate a delicate Geissler's tube. It was also found that when a bar of zinc was placed within the coil of an electro-magnet in the place of its core, and joined by a wire to the gas fittings of the building, faint but distinct sparks could be drawn from any portion of this wire by a second wire proceeding from another part of the gas-pipes. Another peculiar effect was observed when the wire attached to one end of the zinc bar, and armed at its extremity with a thin iron wire, was rubbed lightly against the other end of the zinc bar—sparks being thus obtained, apparently passing from one pole of the zinc bar, through the wire, to the other. Dr. Stone believed he had detected a distinct galvanic taste on applying to the tongue the wire through which the "force" was passing.

PSYCHOLOGICAL SOCIETY.

JANUARY 20TH.—Mr. Serjeant Cox, President, in the chair. The Rev. D. Dutton, Mr. J. P. Gordon, and Mr. A. L. Elder were elected Members, and Mr. Albany de Fonblanque. H.M. Consul at New Orleans Foreign Corresponding Member. The President read some reports of cases from correspondents. Mr. C. C. Massey read a paper "On some Remarkable Psychological Phenomena" witnessed by him in America, which elicited a discussion. The Honorary Secretary announced that the Council invited reports of facts on (1) heredity in man and animals, (2) the superstition of the double, (3) supersensuous perception in somnambulism and its allied conditions.

February 3rd.—Mr. Serjeant Cox, President, in the chair. Mr. P. P. Blyth and Mr. H. Wedgwood were elected Members. The Honarary Secretary reported his interview with Stokes, the witness in the recent murder-case. It was resolved to invite Stokes to attend the meeting of the Society on the 17th inst. The President read a paper "On Matter and Spirit," defining those terms for use in the proceedings of the Society. Mr. C. C. Hussey read a paper maintaining the existence of a soul in man. Mr. Gordon read a paper supporting Prof. Tyndall.

ANTHROPOLOGICAL INSTITUTE.

JANUARY 25TH.—Annual Meeting.—Col. A. Lane Fox, President, in the chair.—The Report of Council for 1875 having been read, a resolution was passed, declaring it to be inexpedient to dispense with the services of a paid secretary. The following officers and council was elected to serve for 1876:—President, Col. A. Lane Fox; Vice-Presidents, Prof. G. Busk, J. Evans, A. W. Franks, F. Galton, G. Harris, and E. B. Tylor; Directors, E. W. Brabrook and Capt. H. Dillon; Treasurer, J. P. Harrison; Council, Dr. J. Beddoe, W. Blackmore, Sir G. Campbell, Hyde Clarke, Dr. J. B. Davis, W. Boyd Dawkins, R. Dunn, D. Forbes, C. Harrison, H. H. Howorth, Prof. T. McK. Hughes, Prof. Huxley, A. L. Lewis, Sir J. Lubbock, F. G. H. Price, J. E. Price, Prof. Rolleston, C. R. Des Ruffières, Lord A. Russell, and M. J. Walhouse.

SOCIETY OF ARTS.

FEBRUARY 8TH.—Prof. C. Tomlinson in the chair.—A paper was read by Dr. Bartlett, "On a New Process for Condensing Beer." The beer is evaporated in a vacuum pan, and the alcohol which first comes over is added to the thick residues obtained when the water has nearly all distilled off. The product thus obtained is stored for use.

February 9th.—Hon. D. Fortescue in the chair. The paper read was "On the Cultivation of Hardy Fruits," by Mr. Shirley Hibberd.

METEOROLOGICAL SOCIETY.

JANUARY 19TH.—Annual General Meeting.—Dr. Mann, President, in the chair.—The Report of Council showed that a large amount of work had been done, and that the number of Fellows had greatly increased. The first-class observing stations, which were organized in 1874, have been in regular working order during the past year; their number has been increased, and several have been re-inspected. An arrangement has been entered into with the Meteorological Office by which the Society has agreed to furnish copies of observations from a definite number of stations. The joint Committee of Delegates from this and other Societies, appointed to draft complete instructions for the observation and registration of natural periodical phenomena, have finished their labours and sent in their Report. A code of rules, entitled "Instructions for the Observation of Phenological Phenomena," has been prepared and published. The Rev. T. A. Preston has discussed the first year's observations, and his Report is given in full. The Council have taken up the solar radiation observations commenced by the Rev. F. W. Stow; but they intend to compare the readings of the black-bulk thermometer *in vacuo* with a bright-bulb thermometer also *in vacuo*, both mounted alike, instead of the maximum thermometer in the shade. The Council have also appointed a Permanent Lightning-Rod Committee, to investigate and record accidents from lightning, to inquire into the principles involved in the protection of buildings, to diffuse exact information regarding the best form and arrangement for lightning-conductors, and to consider all phenomena of atmospheric electricity. The President then delivered his Address. The following gentlemen were elected Officers and Council for the ensuing year:—President, H. S. Eaton; Vice-Presidents, C. O. F. Cator, R. Field, J. K. Laughton, and Captain H. Toynbee; Treasurer, H. Perigal; Trustees, Sir A. Brady and S. W. Silver; Secretaries, G. J. Symons and Dr. J. W. Tripe; Foreign Secretary, R. H. Scott.

CHEMICAL SOCIETY.

JANUARY 20TH.—Prof. Odling, V.P., in the chair.—Dr. Armstrong exhibited a specimen of pure crystallized glycerin from Messrs. Dunn and Co., of Stratford. Mr. E. Neison communicated a "Note on Sebate of Cobalt,"—Dr. C. R. A. Wright, gave an abstract of Part IV. of the researches by himself and Mr. G. H. Beckett "On Narcotine, Cotarnine, and Hydrocotarnine:

On Oxynarcotine, a new Opium Educt, and its Relationship to Narcotine and Narceine,' —and Mr. M. M. P. Muir read a paper "On a Method for Estimating Bismuth Volumetrically."

February 3rd.—Prof. Abel, President, in the chair. Mr. W. Ackroyd read a paper "On Metachromism, or Colour changes," in which he discussed the phenomena presented by certain chemical compounds which changed colour on being heated. Mr. W. H. Perkin made a communication "On the Formation of Anthrapurpurin," which it appears is the product of the action of caustic alkali on anthraquinine-disulphuric acid; the supposition that alizarin is formed under these circumstances being incorrect. There were also papers "On Maltose," by Mr. C. O. Sullivan. "On a simple form of Gas Regulator," by Mr. T. Fletcher, and "On high Melting-points, with special reference to those of Metallic Salts," by Mr. T. Carnelley, B.Sc.

LINNEAN SOCIETY.

JANUARY 20TH.—Prof. G. J. Allman, President, in the chair.—Prof. Oliver communicated a short paper by Prof. H. G. Reichenbach, being the twenty-ninth contribution to the botany of the Challenger, "On some Orchidaceæ collected by Mr. Moseley, of the Challenger Expedition, in the Admiralty Islands, Ternate, and Cape York," one of which forms the type of a new section of the genus Dendrobium. "On the Fungi of Brazil," by the Rev. M. J. Berkeley and Dr. M. C. Cooke. The authors include the collection made by Mr. J. H. Trail in 1874, and state that all the Brazilian fungi yet known amount to but 437 species. Among these there are of Hymenomycetes, 356; Gasteromycetes, 13; Hyphomycetes, 7; Coniomycetes, 5; Ascomycetes, 55; incomplete, 1. About 300 of these are confined to Brazil, the remainder found in other parts of the world. The great Brazilian region, therefore, with but 437 representatives, contrasts with 886 enumerated for Cuba, and 1,190 for Ceylon. This paucity of species in the first-mentioned area, the authors suggest, may be due to incompleteness of collection, or presumably as yet from deficient knowledge of microscopical forms. "On a New Species of Oak from the Sikkim Himalaya," by Dr. G. King. This, the *Quercus Andersoni*, or "Katoos" of the Nepaulese, is one of the finest forest trees, and largely used by the European residents of Darjeeling. It occurs at higher altitudes than *Q. spicata*, and in other respects differs. "On Steere's Sponge, a new Genus of the Hexactinellid Order of the Spongida," by Dr. J. Murie. Obtained in deep water between the islands of Negros and Zebu, the present adds one rarity to the already remarkable sponge fauna of the Philippines. The siliceous skeleton of *Dendrospongia Steerii* bears resemblance to a branching coral or shrub, and is nearly three feet high. A peculiar rosette-like series of tufts form a continuous whorl, winding spirally up the branches. Microscopical examination shows the spicules to belong to the sexradiate type; the character of these, with the presence of a veil and other structural points, indicate its being an intermediate type between such forms as Dactylocalyx, Aprocallistes, Holtenia, and Meyerina. The homology of the so-called root, body, and beard spicules of several of the siliceous sponges being noted, those of Dendrospongia are compared, the spiral tufts of the latter agreeing in many respects with the spicular fringes of Euplectella, &c.

February 3rd.—Prof. G. J. Allman, President, in the chair.—Mr. W. Hillhouse, Prof. R. Lankester, Mr. D. Pigeon, and Mr. D. Robertson were elected Fellows.—Mr. A. Peckover exhibited a case of insects from Madagascar, obtained by Mr. Kingdon. Among these Mr. Butler pointed out and made remarks on the scarce and remarkable *Actias Idæ* of Felder's "Reise der Novara'; the new hawk-moth *Diodo, sida*, sp., allied to a Congo species; also *D. fumosa*, Walker, the *Danais chrysippus*, L., and its mimic, *Diadema missippus*, L., likewise a homopterous genus, allied to Coomoscarta of Stal. Mr. H. Trimen read a "Note on *Bœa Commersonii*, R. Br." He observed that the supposition of Commerson having obtained the type in Magellan Straits is founded on an error; R. Brown regarded it as belonging to Seychelles. Mr. C. Walter quite lately has discovered specimens growing on coral cliffs in the Duke of York's Island, which, through the Baron von Mueller of Melbourne, have been forwarded to this country for identification. The probability is that Commerson himself obtained his examples in 1768 from the same locality, its true habitat having been confounded from the name "Praslin," attached to the original specimen, being given to widely different places. Mr. B. Sharpe read a paper "On the Geographical Distribution of the Vultures (Vulturidæ)." These he divides into two sub-families, Vulturinæ, with six genera, and Sarcorhamphinæ, with four genera, the distinctive characters and geographical range of which were commented on. The author likewise sketched out the classification of the birds of prey, as proposed by him in recent publications. A short paper, "On New British Lichens," by the Rev. W. A. Leighton, was taken as read: six new species are described and figured. The Rev. J. M. Crombie made a few observations on two communications by him, viz., "Lichenes Capensis, an Enumeration of the Lichens Collected at the Cape of Good Hope, by the Rev. A. E. Eaton during the Venus Transit Expedition in 1874,"—"Lichenes Kergueleni, an Enumeration of the Lichens Collected in Kerguelen Land, by the Rev. A. E. Eaton during the Venus Transit Expedition in 1874-5."

INSTITUTION OF CIVIL ENGINEERS.

FEBRUARY 1ST.—Mr. G. R. Stephenson, President, in the chair.—The following candidates were elected:—Sir S. Canning, Major R. C. B. Pemberton, Capt. S. S. Jacob; Messrs. D. Cunningham, T. R. Salmond, J. S. Story, and J. P. H. Walker, as members; and Messrs. J. Allison, W. Brentnall, W. J. Cadett, W. A. Carter, J. Cartmell, B. J. Fisher, H. J. Handley, J. Hardwick, G. Haycraft, G. C. Hewitt, H. G. Huxley, W. Johnstone, I. M. Jones, W. R. Jones, T. Kidd, jun., A. H. Le Breton, G. A. Lundie, A. Marshall, W. B. Myers, B. Nubar, M. M. Paterson, R. Pickwell, H. Richards, J. Rigby, W. Russell, H. W. Saxton, W. H. Scriven, W. C. Street, B. Symons, J. Webster, and J. M. Wrench, as associates. The council reported that they had recently transferred Mr. W. Hunt from the class of associate to that of member, and had admitted Messrs. R. S. Robinson and G. Atkinson van Sommer as students of the Institution. The paper read was "On the Holyhead New Harbour," by Mr. H. Hayter.

February 8th.—Mr. G. R. Stephenson, President, in the chair. The paper read was "On Carlingford Lough and Greenore," by Mr. James Barton, M. Inst. C.E. It was stated that the mouth of Carlingford Lough was sheltered by a natural breakwater of rock, leaving a channel about 700 feet wide. Across this channel a bar of blue clay and boulders had existed previous to the works described, the depth of water being only 7½ feet at low tide. Within the Lough the water was more than 18 feet deep at low water over an area of 1,200 acres, affording safe anchorage. Although the cutting of a channel for navigation through this bar had been recommended by the Tidal Harbours Commissioners and by the Refuge Harbour Commissioners, it had not been carried out as a public work, but was undertaken locally under the Piers and Harbours Act, and was authorised by Parliament in 1864 to be executed by a Board of Commissions, for which purpose a sum of £80,000 was lent by the Public Works Loan Commissioners on the security of expected tolls. The exposed position of this work was somewhat unusual for dredging. The number of days in the year when the weather permitted the dredging to proceed, varied from a minimum of sixty-seven in the year 1871, to a maximum of one hundred and thirty-one in 1873, and upon many of these days the work was limited to two or three hours. The materials raised per season varied from 50,000 tons to 99,720 tons; the clay was generally blue and plastic, with boulders embedded, varying in size up to 4 tons in weight. The dredging plant had been specially designed, and was constructed by Messrs. Simons and Co., of Renfrew; it dredged in water 35 feet deep, and lifted stones up to 30 cwt.; the larger ones were chained by divers and raised by a crane on the vessel's bow. The average lift for all days on which the dredger worked, whether one hour or sixteen hours, had been 850 tons; the maximum tonnage raised in one day was 4,000 tons. Some rock inside the Lough had been removed by first blasting on the surface with dynamite, and then dredging the broken-up rock, The channel already formed was 18 feet deep at low water of spring tides for a width of 300 feet, and a further width of 50 feet at each side had been cut to a depth of 14 feet at low water. The channel was intended to be 600 feet wide, and 18 feet deep at low water. The cost of the works, including insurance of plant and Parliamentary contests, &c., had been approximately 1s. 9d. per ton. The cost of the actual work for any one season varied from 1s. 4d. to 1s. 6d. per ton. Two leading light-houses had been erected to guide vessels through the channel, which was about ¾ mile long. Within Carlingford Lough a point stretched out to the edge of deep water from the south side called Greenore, and here, 3 miles inside the bar, a marine station had been constructed and a railway to it formed from the Irish North-Western Railway at Dundalk, and another was in process of construction from Newry. This point afforded special facilities for a fixed hour steam service to Holyhead and elsewhere. The works at Greenore had been designed to provide for the convenient loading and unloading rapidly of steamers, with passengers, cattle, and goods, and to provide for the necessities of each kind of traffic, so as to enable the passengers to land and embark without contact with either goods or live-stock traffic; and yet that these should not be inconvenienced, but that each should be done in the best way. The arrangements were explained by diagrams, and a system of hydraulic machinery raised and lowered the landing stages. There were two berths for steamers and a collier berth, and one of the former was deep enough to accommodate grain vessels afloat alongside having a depth of 18 feet at low water. Movable lifting landing stages, to suit the steamers at all times of the tide, were provided, by which passengers were sheltered and under cover until embarkation, and special arrangements were provided for communicating with these stages by a novel description of stairway, in which the steps maintained their horizontal position, whatever inclination might be given to the frame which carried them. The quay wall at the sea end was founded at a depth of 21½ feet below low water, and at the upper berth, of 18½ feet. The foundations were excavated by dredging, and were levelled by divers. The front of the land end of the wall below low water was formed of concrete blocks of about 3½ tons, set by divers, and the back face of the wall had been formed of concrete in sacks, containing about 1 cubic yard each, put down soft, and built in courses; and the hearting was of concrete deposited soft. The foundation at the sea end had been formed of concrete blocks of 100 tons each, built upon the beach above low water in frames, and lifted, carried, and lowered between two barges by special machinery worked by hand. Two of these blocks, one upon the other, formed a length of 10 feet of the wall up to low water. Above low water the wall had been built of heavy rubble limestone masonry, and it was fendered throughout. The fenders for the steamer berths were necessarily of special construction, inasmuch as the lifting stages had to be free to move behind them; they were formed of heavy wrought-iron box girders stayed to diagonal struts, by which the pressure was carried down to the foundations. The cost of the works at Greenore had been £130,000. The cost of the quay wall, 45 feet high on an average, had been, including extras, £27 8s. pe lineal foot. The concrete used was 1 of Portland cement to 6 of sand, gravel, and stones. The cost of the concrete blocks of 100 tons each, when set, exclusive of barges and machinery, had been 30s. per cubic yard. That of the concrete built in the back face of the wall in sacks had been 23s. per cubic yard, while the cost of the liquid concrete set in the foundations had been 18s. per cubic yard.

ON RAILWAY SAFETY APPLIANCES.

By Mr. Thos. Morgan, Assoc. Soc. of Engineers.

The following is the substance of the paper by Mr. Morgan, read at the meeting of the Inventors' Institute on 27th January last:—

It is conceded as a fact I should presume by most persons that a reliable system of signalling on railways would be a great desideratum.

The accidents and loss of life resulting through defects in signalling apparatus, that we have so frequently to deplore on railways, if we had a reliable system, would be reduced in a very great degree. For I may be permitted to say, if, in the most recent accident, that at Abbot's Ripton, reliable signalling were in operation, I doubt whether we would have to chronicle so great a disaster, although even what may be termed a reliable signal might in some extreme cases fail. There is no doubt, however, the extreme state of the weather in this lamentable accident may in part have resulted in causing the disaster.

Accidents on railways result from various reasons. Amongst others, either from neglect of signalmen in attending to their duties, or of the drivers of trains from the same cause, or from both combined. Or, neither the drivers nor signalmen may be in fault, as in the present almost universal defective system of signalling, the state of the weather may be the primary cause of the evil. In the case of the last cause of fault it may be that the signalman has given the proper signal, as he thinks, with a result, through the contraction or expansion of the wire connecting the signal with the lever, that the signal, although it may be pulled over so as it would be presumed to bring the signal to Danger, the arm of the signal assumes a position neither of Danger or All-right, which is often the case. On the driver of a train passing such a signal meant for Danger, but which lies in a position intermediate, he may take it as All-right, and dash on, meeting with the result that every one is aware of.

To rectify this state of things much inventive talent has been expended. Number of well-known inventors have taken up the matter with a view, if possible, of putting matters on a more sure and reliable basis.

One of the greatest causes of defective signalling is, I think, that caused by the state of the weather, viz., the contraction or expansion of the wire which connects the signal with the machine in the signal box.

Amongst the various inventions, I may enumerate one which has been somewhat used for counteracting this latter evil, that of Mr. Benyon, which, in the main, consists of a bar mounted on friction rollers, to which bar the wire from the signal is connected at one end, and to take up the expansion or contraction of the wire. a weight is attached to the other end.

By another patent, that of Messrs. Ledbrook and Mills, a metal slide or bar perforated with holes is used for like purpose, of meeting the contraction and expansion of the wire.

I might also enumerate various other inventions in connection with the improving of our system of railway signalling, such as those of the eminent firm of Saxby and Farmer, also those of Mackenzie, Dutton, and Spagnoletti.

All these and various other plans have been found to have their advantages and disadvantages, some will say there are both these in the plan I have the honour of submitting to this meeting.

Some persons, well-known inventors and improvers on our present system, who are electricians, hold that there is nothing to be compared to electricity in order to ensure certainty and correctness of signalling on railways.

No one can assert, I should imagine, but that electricity has been one of the greatest revolutionizers in the world's progress. In the comparatively excellent state it now is in one would be inclined to think that it would be the best thing for ensuring the accuracy of signalling on railways. But in answer to this other persons hold that for purposes of ensuring accuracy of signalling, electricity is out of place, and that as it is so susceptible of being at fault through the weather and other causes it is not reliable. Electricity, there is no doubt, up to the present is one of the principal forces used for telegraphing on railways.

Now, it is not my intention to occupy the time of this meeting by comparisons of the merits or demerits as to whether electricty is the best and most advantageous for giving signals on railways, or whether electricity be entirely out of place in such purposes.

I have enumerated a few names of well-known inventors for signalling for railways, but the invention and patents, the models you see before you, are those of Mr. John Ford, of Reading, who has devoted much time, labour, and thought, and gone to considerable expense in securing, perfecting, and developing his inventions, with the result, so far as the signalling is concerned, of the models before you.

Some of the principal advantages of this plan of signalling are—

1. That a reliable and true signal is obtained whether the signal be a home danger or other signal.
2. The signal is controlled when inside or outside of the signal box.
3. The signals may be arranged either to tell-tale or not.
4. Contraction and expansion of the wires are taken up from the box, affecting thereby a considerable saving in the working of the signals, dispensing, as it does, with the men at present employed in readjusting the wires, as they do now, according to the state of the weather.
5. Tampering with signals is instantly detected by the signalman.
6. In all cases of breakage of wires, the signals fly to Danger, thereby ensuring that should (from any defect) a breakage occur, the signals will fly to that position which will tell the driver to stop; and, at the same time, the signalman will be aware that something is amiss, and can take such steps as will ensure the safety of the passengers in the train.

Having enumerated some of the advantages for which this apparatus is adapted, I will now proceed to state the various principal parts which effect these advantages, and afterwards I will proceed to describe the mode preferred for working the various signals by this apparatus.

The principal new parts are—

1. The ratchet arrangements.
2. The sliding link, which serves to take up the contraction or expansion of the wire.
3. The compensating lever, which also acts for taking up slack, and as a compensation for the arrangements.

Having enumerated the principal parts of the new apparatus, I will now give a general description as to their working, leaving it to be definitely pointed out by the model, wherein I shall adopt the description given by Mr. Ford in the specification of his patent, as follows:—

The ratchet is placed in a frame or box on the floor or on the machine in the locking gear box, and underneath this ratchet I place an arm or lever working on a pin, but at the ordinary distance from where it works on its centre in the ordinary signalling lever. A vertical rod works through the floor up to the quadrant attached to the lever; this lever works the repeater or tell-tale. The wire or chain will also work through the floor to the ratchet. In locking gear boxes there is a space below the floor to allow the arm to be three or four feet from the floor line, which gives space for the arm and lever to work a distance from the ratchet. The ratchet can be placed in any convenient part in the box on the machine. The wire runs from the ratchet to the travelling link or guide bar with a pulley or pulleys in its centre or other position (in the case of the model in the centre), which is preferred working between cheeks. This chain goes round the pulley in the centre of the link or guide bar, the chain wire from the ratchet being attached at one end of the link or guide bar to pull up the slack when necessary, that is, when the self-acting compensating lever requires readjusting, which occurs when the contraction of the wire has run out or upon expansion of the wire to put the compensating lever in its right place, this being governed by the tell-tale arm or signal which acts with it. If the contraction be run out and the compensating lever comes in contact with the frame, this brings the repeater down and shows the contraction of the wire or chain, same being under control in letting out with the ratchet, and the same on taking up. The wire or chain passes round the pulley on the link, and is secured to shackle at the bottom of the compensating self-acting lever. The chain from the lever working tell-tale passes around pulleys in said lever, the wire or chain runs over the pulley on one side down at the back of another pulley in a solid check arm to the distant or any other signal with the ordinary arm and weight attached to it. This vertical lever works in a pair of cheeks or stands between or at the centre of same as near as can conveniently be got; these may be coupled together if required. The link works in brackets, guides, or rollers, and can be elevated to suit any incline.

Should there be any objection to the lever in the cheek frame being sloped by the stretcher between the quadrant, the whole of this arrangement can be taken out and leave the quadrant and lever free between the quadrant as the centre pin that it works upon will keep the frame together, and by reason of each cheek being bolted down to a bed plate with flanges on each side the whole will be made square.

Although the quadrant can be dispensed with if thought desirable, provision is made in the cheeks to work against the long boss on the lever which forms a guide for same. This arrangement is called an endless contraction and expansion apparatus as any practicable quantity of slack may be taken up by lengthening the link and enlarging the ratchet wheel in the box.

Another arrangement sometimes used is fixed on a plank with a cast iron plate with a centre pin for the lever to work on. The lever has a long boss to receive a tie welded on the lever to keep it in position on the lever plate; this lever plate has a circular raised surface, such lever having two projecting arms which may be either portable or fixtures. This lever has cheeks the same as in the arrangement above described, and also stretchers between the cheeks to keep the same in position at the ends, such arrangement of lever being to suit station yards where a vertical lever would be objectionable; the whole can be put into a box and worked under the line of rails.

The arrangements for gong ringing and to ring between by the guard of the train (that is, between the blocking boxes) to repeat both ends at once gongs may be used fixed to the box and to repeat same as a signal.

I have thus enumerated the principal portions of the arrangements and their general disposition in the working of the signals.

As stated, the arrangements are used for any signals—home, distant, sight, or other signals, and these may be arranged to tell-tale or not as desired.

And the arrangements may be used whether the signal be near or at a distance, or out of sight of the signal box, as the signalman is assured by his tell-tale whether the signal is in its right position or not.

To practically demonstrate the use of the apparatus I will now proceed, with the aid of the model, to show its working:—

1. Working home signals with tell-tale.
2. Working distant signals.
3. Working sight signals.

These three modes of signalling practically embody the main parts of signalling, and we will proceed now to their demonstration, and, with a view to being perfectly understood, we will refer to the model.

In working home signals, and tell-taling the same, the whole of the working arrangements are used.

1. The front lever represents one of the levers of the ordinary machine. The lever with the ratchet is set at the back of the said lever. The wire or chain from the lever proceeds and passes over the pulley on the link, and back again under a pulley to the ratchet arrangements, to which it is connected. The lever of the tell-tale is connected to the wire, which proceeds and passes over the pulley at the upper part of the compensating lever down and under the pulley at the bottom of said compensating lever and thence to the home signal. It will be noted as regards the compensating lever that it is generally at about 45°, so that there is very great latitude allowed for taking up the slack of the wire.

2. In working distant signals, Mr. Ford can dispense altogether by his arrangements of working with the ordinary machine, and work direct from his ratchet arrangements. In this case of working distant signals, the sliding link is not used, so that the wire from the compensator is discontinued from the link, and a connection is made by wire attached to the end that was previously on the link to the chain that in the last illustration went over pulley on the slot.

The result you will clearly perceive far better than words can express by the model as worked.

3. In the case of sight signalling, the link is again connected as described in the case of tell-taling home signals, but in the case of the compensator, this is here thrown out of gear, the wire from the end of the link being (in the model) connected to the wire to the signal, and forming a connection therewith.

So that in these three different modes of signalling it is seen that the lever on the machine and also the ratchet arrangements in tell-taling home signals is brought into requisition, together with the other parts of the mechanism. The ratchet in working home signals is always put at the back of the lever on the machine.

In the case of distant signals, the ratchet alone is preferred in working this signal.

In the box it is placed at the side of the lever on the machine, and not as in home signalling, at the back of the lever on the machine.

In all cases of working signals, according to these arrangements the lever of the machine is pulled over first, then the ratchet lever in putting the signals to Danger; but when the signals are required to be brought to the All-right position, then a reverse action is required; and to prevent the distant signal being worked before the home signal, a stud is placed on the ratchet lever arm to effect this.

On expansion of the wires of the signal, the tell-tale with the distant or home signal rises a little. This can be at once counteracted by taking in a notch or two on the ratchet.

In the case of contraction, the tell-tale falls, then all that is necessary is to let out a notch or two on the ratchet.

A discussion followed the reading of the paper; in which the Chairman, Mr. J. McLauchlan, Member of Council (acting in the unavoidable absence of Sir Antonio Brady), Mr. Allardyce, Mr. Smith, Mr. Jones, and other gentlemen took part; the views expressed being generally favourable to the practicability of the invention. Mr. Campin proposed, and Mr. Smith seconded a vote of thanks to the reader of the paper, and Mr. Ford, the inventor; which, with a vote of thanks to the chairman, being carried by acclamation, the meeting was closed.

[At this meeting Mr. Redman exhibited the model of his self-acting coupling, and explained its mode of action; full particulars of which we hope shortly to present to our readers.]

SHIP GEAR, &c.

A CORRESPONDENT, moved by the account of Coxhead's ship gear in the November number, writes:—

"The most authentic account in the American papers of the death of the late Lord Aberdeen, represents him as having become entangled with a rope of one of the masts of a schooner—bound from Boston to Australia—a rope which does not exist for the particular mast. It is a curious fact that a great many experienced persons read without commenting upon the strange fact. It appears that in the beautiful warm latitudes of the Gulf of Mexico a storm came on and, within sight of land, this unfortunate nobleman became so entangled, fell into the water, and could not be rescued. The writer has been twice in the latitude given, and has never seen any particular storm; indeed, the sea was as placid as a lake with parks upon parks of sea-weed 'floating wide.' It will naturally follow that, for years to come, the crews of British naval and merchant ships passing latitude will think of the gallant heart 'sleeping serene and safe from tempest and from billow,' though there may be, in point of fact, few storms that above him chafe to 'scarce reach his peaceful pillow.' Yet, in the account mentioned, no one saw him drown.

"No doubt the probabiltiies are that he is dead, and if not entangled by ropes, must have been hit by a spar or block. This suggests that in the interest of humanity the attention of inventors should be directed to making the gear of vessels as complete as possible.

"Now, I have travelled in emigrant vessels very long distances indeed, and have seen flying blocks repeatedly, but never a serious accident. Still accidents of some kind result therefrom, and some means of making them stronger and securing them better should be tried. I believe there are some patents on the subject, but there is room for more. I have noticed some of them partly broken before reaching the deck, and have often dodged them. When the crowded deck of large emigrant vessels is considered, one cannot over-rate the necessity for improvement. Again, in the Atlantic, I have seen the higher sails carried away in a gale, owing to the strength of the sailor to secure them being quite inadequate. Those sails with better resources would not have been so seized. On men of war and some of the first-rate emigrant vessels there are very good appliances; but for general use there ought yet be some handy and not too costly appliances.

"The poop bulwarks and the life-boats attached thereto are frequently stove in and carried away in the case of vessels sailing to Australia. Stronger ropes and cables are needed generally, as well as in regard to the numerous bays and entrances to harbours in different parts of the world, where steamers and vessels run aground as a matter of course.

"In one colonial bay, the ocean steamers run aground every day, and I have seen the ropes and cables constantly breaking or causing some annoyance and danger.

. . . .

"On the score of greater comfort, and in regard to minor accidents, I may mention that not even now can dishes be secured on the table, nor the passengers sit securely at meals in a rather severe storm."

INSTITUTION OF NAVAL ARCHITECTS.

The following are subjects on which communications are desired at the next annual meeting (April, 1876):—1. On the construction and armament of ships of war. 2. The effect on naval construction of torpedoes, or other modes of submarine attack. 3. On the life and cost of maintenance of merchant steam-ships. 4. On the preservation of the hulls and cargoes of ships from the effect of bilge-water, leakage, condensation, and other causes of internal decay and corrosion. 5. On the disposition and construction of bulkheads, and on their attachment to the sides of iron ships. 6. On the masting of ships, and on iron and steel masts and yards. 7. On the ventilation of ships by natural and forced draughts, with details of any system in actual operation. 8. On the fouling of ships' bottoms and its prevention. 9. On machines for the economising of labour in the construction of ships. 10. On the use of machinery for economising labour on board ship, whether merchant ships or ships of war, and whether for loading or manœuvring. 11. On telegraphic or other communication of orders on board ship. 12. On the construction of slips and launching ways, and on the launching of large ships. 13. On the present state of knowledge of the strength of materials as applied to shipbuilding, with especial reference to the use of steel. 14. On methods for the proper strengthening of ships of extreme proportions, and the precautions necessary to ensure their safety at sea; also on the lengthening of ships. 15. On the straining effects of engines of high power on the structures of ships, and the arrangements necessary to obviate them. 16. On legislative interference with the construction, stowage, and equipments of ships. 17. The design, construction, and measurement of yachts. 18. On floating structures other than ships—such as docks, lighters, pontoons, and so forth. 19. On ships for special purposes—such as light ships, telegraph ships, cattle and special passenger ships, and others. 20. Actual measurements or records of sea-waves: their height, length, periodic time, and speed of advance; or their profiles. 21. On the results of the best modern practice in ocean steam navigation, with reference to the latest modern improvements—such as surface condensation, superheating, compound engines, and the like; also the value of each of these taken separately, and especially the results of any actual experiments to test this point. 22. On the friction developed in marine steam engines of different forms; and on the difference between the gross indicated horse-power developed in the cylinder, and the net effective horse-power available for the propulsion of the ship after working the air-pump, slide-valves, and other moving parts of the engines. 23. On economy of fuel in marine engines, with detailed results. 24. On methods for starting, stopping, and reversing marine steam engines of high power. 25. On marine boilers, their form, rate of combustion, and the proportion of their various parts. 26. Information as to the alleged rapid deterioration of marine boilers supplied with water from surface condensers and the remedies for the same. 27. Exact information (either experimental or theoretical) on the efficiency of propellers. 28. On any novelties in the construction, equipment, or fitting of ships. 29. On any novelties in the construction, arrangement, or details of marine engines and propellers. —A. Sedgwick Woolley, Secretary, 20, John Street, Adelphi, London, W.C.

DRAMATIC LITERATURE.

The Princess's.

At this theatre the great American actor, Mr. Joseph Jefferson, is playing "Rip van Winkle; or, a Sleep of Twenty Years." Most of our readers will be familiar with the story from the pages of Washington Irving. The unfortunate Rip is a drunken peasant who goes out shooting, taking a cask of spirits, and is captured in a state of intoxication, and held in slumber for twenty years, returning to find his wife dead, and no one able to recognize him. We had the pleasure to see the same piece, with Mr. Jefferson taking the same *role*, in the colonies, in 1862. His rendering then was of an extremely vivacious and striking character, and it is impossible to forget the intense melancholy which characterized his acting in the return to the village, and finding himself as it were a weak, despised Lear. We yet remember his most touching exclamation of "Meenie! Meenie!" his daughter's name.

In witnessing the performance at the Princess's Theatre, we found repose—comparatively speaking—had been introduced into the part, which might suit a London audience better, though his vivacity as a colonial actor was pleasing in its way. Most of the audience appeared to appreciate the humour exceedingly. There is no doubt, also, that Mr. Jefferson's manner possesses undeniable charm, which partly lies in great ease and self-possession, and a peculiar quietness, accompanied by a degree of dash—the latter quality being, however, more displayed in his excellent rendering of Caleb Scudder, in "Our American Cousin."

The principal scenes are where Rip is expelled from his wife's house in a storm of thunder and lightning, the interview with the spirits, and the concluding scenes of his return. The artiste's conception of the tipsy peasant in the first of these deserves very great praise, and the pantomime in the interview with the spirits was picturesque. The rendering by Mrs. Alfred Mellon of the *role* of Greitchen, Rip's wife, was *prononcée* and natural, and Miss A. Hamilton behaved nicely as Meenie. Considering the number of nights the piece has been played, it was gratifying to observe the large audiences.

Theatre Royal Drury Lane.

The pantomime of "Dick Whittington and his Cat" continues on the boards at this theatre, and is to go on till 4th March. Of course Mr. E. L. Blanchard is, as usual, the author. He is a stage writer of repute, though some tendency was shown to substitute elegance and other qualities for those of the good old fashioned pantomime; the performance was very sprightly. We would be inclined to favour an adherence to the good honest Christmas fun and enjoyment which are dear to us as Englishmen from boyhood, rather than return to the Italian caprices. To theatres like Drury Lane we look to maintain the legitimate style; which we believe is usually aimed at by Mr. Chatterton. Some American ladies of the name of Vokes are the principal attractive persons in the harlequinade. They are very springy and merry; Miss Victoria Vokes is Dick Whittington, and Mr. Walter Vokes the Cat. The procession with the cat in a state carriage to the accompaniment of triumphal music is capital, and provoked roars of laughter. The dresses of all the performers were very pretty, even magnificent. Some of the fairies and ballet dancers appeared to be attractive. The costumes are by Mr. Vokes and Mrs. Lawler, designs by Mr. Alfred Maltby.

Royal Surrey Theatre.

We visited this theatre understanding that a very good specimen of the old fashioned pantomime was offered. We were not disappointed; and strangers visiting London will find a good deal of the generous, boisterous, pantomime fun at this theatre, together with lively extravagance, in which latter Miss Nellie Moon, with whose elegant figure many Londoners are familiar from the photographs, performed most gracefully and delightfully. She had the typical character of Folly to render, and give the songs of the part, which she did with great force. Our old friend Jack the Giant Killer, the widow's mite, and the pet of everybody, found a good representative in Miss Jemmy Lee. The spirit with which she and the other ladies performed their parts excited, deservedly, much applause. One of the actors wearing a white hat, an old fashioned tail coat and light trousers, with enormous stripes, created much amusement by his jokes all through the evening. Jack's mother, by Mr. Taylor, displayed good comicality of the London school. The fairies danced very successfully, judging from the plaudits bestowed, and their disposition *en tableaux* was rich and in good taste. The transformation scenes of this theatre are worth seeing. The manager, Mr. Holland, responded after one of these, and announced various new arrangements.

AMERICAN INVENTIONS.

Improved Water Wheel.—Adam W. Haag, Fleetwood, Pa.—In this invention the novel features consist in a spring which throws the points of the gates into notches in guides when they close, to shut said gates tightly; also in cams, contrived to hold the rings and buckets shut; a V-shaped rib, which presses into the flow of the penstock, to pack tight and prevent leakage; and a shaft bearing in two parts, secured together by a ring.

Improved Horse Power.—William I. Grant, Magnolia, Ark.—This is a method for attaching the sweeps to the shaft or king post of the ground wheel by a frame attached to arms radiating from the shaft. The sweeps are thus supported on the opposite sides of the shaft at considerable distance therefrom. An increased leverage is obtained, and the king post is made very firm.

Improved Pump. — William Young, Easton, Pa.—The pump barrel is attached to a vulcanized or galvanized gas pipe, which passes into a base plate and also into the handle bracket, in both of which it is adjustable. A waste valve attached to the pipe is arranged to close by the pressure of water when the pump is working, and is provided with a spring which opens it when the pump stops, thus allowing the water to run out, and so preventing freezing.

WEBSTER & WEBSTER, MOELLN.—Not content "to wait on Providence." Cannot Holder proceed against Relative for restitution of the "*Parcel*," without disclosure of its contents? This suggestion is consequent on your own proposal in letters of May 27th and July 3rd, 1875, and should be acted on without delay.

Disappointed at not having received a Foreign address.

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